TIMBER SUPPLY BRANCH

TIMBER SUPPLY REVIEW

Kootenay Lake Timber Supply Area Analysis Report

March 2001

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Kootenay Lake Timber Supply Area Analysis Report

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Preface

This report contains a timber supply analysis and a social-economic analysis and is part of the provincial Timber Supply Review (TSR) carried out by the British Columbia Forest Service. The purpose of the review is to examine the short- and long-term effects of current forest management practices on the availability of timber for harvesting in timber supply areas (TSAs) and tree farm licences (TFLs) throughout British Columbia.

To determine allowable timber harvesting levels accurately and rationally, the chief forester must have an up-to-date assessment of the timber supply, based on the best available information and reflecting current management direction. **The report that follows provides this assessment but should not be construed as a recommendation on permissible harvest levels.**

This report focuses on a single forest management scenario — current management practices. Current management practices are those practices governed by legislation (*Forest Practices Code*), official land-use decisions made by cabinet and the criteria used by the District Manager to approve a *Forest Development Plan*. Land use and management issues that are not current management may be examined if formal decisions are pending and the issues could be of importance to timber supply and the chief forester's determination.

An important part of these analyses is an assessment of how results might be affected by uncertainties — a process called sensitivity analysis. Together, the sensitivity analyses and the assessment of the effects of current forest management on the timber supply form a basis for discussions among stakeholders about alternative timber harvesting levels.

In addition to having an up-to-date assessment of timber supply when setting the allowable annual cut (AAC) the chief forester considers short- and long-term implications of alternative harvest levels, capabilities and requirements of existing and proposed processing facilities, and the social and economic objectives of the Crown. The socio-economic analysis provides the chief forester with some of the information necessary for these considerations.

The socio-economic analysis considers forestry activity associated with the harvesting and processing of timber harvested from the TSA within the context of regional industry timber supply and production capacity. This report is the third of five documents that will be released for each TSA as part of the Timber Supply Review.

This document provides detailed technical information on the results of the timber supply and socio-economic analyses. A separate document called the public discussion paper will summarize the technical information regarding possible timber harvest levels and will provide a focus for public discussion. The fifth will outline the chief forester's harvest level decision and the reasoning behind it.

Executive Summary

As part of the provincial Timber Supply Review, the British Columbia Forest Service has examined the availability of timber in the Kootenay Lake Timber Supply Area (TSA). The analysis assesses how current forest management practices affect the supply of wood available for harvesting over both the short- (next 20 years) and long-term (next 250 years). It also examines the potential changes in timber supply stemming from uncertainties about forest growth and management actions. **The various harvest forecasts included in the report are intended for discussion purposes only; they are not allowable annual cut (AAC) recommendations.**

The Kootenay Lake Timber Supply Area (TSA) is situated in the south-central portion of the Nelson Forest Region and is administered from the Kootenay Lake Forest District office in Nelson. The TSA is centred around Kootenay Lake, and runs in a long strip from the U.S. border in the south to Glacier National Park in the north. It is bounded by the Arrow TSA on the west and by the Invermere and Cranbrook TSAs to the east. The principal communities are Nelson, Creston and Kaslo. The terrain of the Kootenay Lake TSA is generally mountainous, with areas of gentler terrain in the south.

The Kootenay Lake TSA covers approximately 1.2 million hectares (ha). The TSA encompasses significant areas of private land and timber agreement lands that are not currently under B.C.F.S. management. The B.C.F.S. analysis indicates that almost 50% of the total TSA area is productive forest land under Crown management, but only 257 850 hectares (21%) of the total area is currently Crown managed timber harvesting land base.

The forests of the TSA are critical to the provision of wildlife habitat, quality drinking water and a thriving tourism industry. Considerable attention was paid to assuring the analysis accounts for the areas where timber harvesting is not permitted or is limited by overiding non-timber objectives.

Given current management assumptions, the analysis shows that the initial harvest level of 691 000 cubic metres per year, which is 9000 less than the current AAC, can be maintained for 50 years with an orderly progression between 50 and 70 years to a long-term harvest level of 605 000 cubic metres per year.

Significant changes in AAC, the land base available for timber harvesting, growth models employed for assessing managed stand yields and the nature and implementation of various non-timber objectives have resulted in some substantial changes in the base case harvest forecast presented in the previous timber supply review. These include: an initial harvest level which is almost 14% lower, but sustained for 30 years longer and a long-term harvest level which is 23% higher than the 1993 analysis.

Many of the data and assumptions used in the analysis are subject to varying degrees of uncertainty. Sensitivity analysis was used to determine how uncertainty about various data and assumptions affect the results of the timber supply analysis.

In the short term, timber supply is highly sensitive to (1) lower yield estimates for existing stands, and (2) tighter forest cover guidelines in visually sensitive areas, and (3) not aging forest excluded from timber harvesting.

In addition to these factors, the period of time over which the initial harvest level can be sustained could be shortened by (1) reducing the timber harvesting land base, (2) increasing green-up ages, (3) specifying biodiversity constraints separately on the timber harvesting land base and the productive forest, (4) increasing the caribou or ungulate winter range habitat objectives, (5) reducing the disturbance allowable in community and domestic watersheds, (6) specifying full old seral biodiversity objectives immediately.

The period of time over which the initial harvest level can be sustained may be extended by: (1) increasing existing or managed stand yield estimates, (2) applying old growth site index equations, (3) applying genetic worth estimates, (4) reducing green-up ages, (5) reducing caribou habitat cover objectives, (6) increasing the area of timber harvesting land base, (7) specifying that the oldest or relatively oldest stands are harvested first, (8) reducing visual quality objectives or, (9) reducing the landscape-level biodiversity old seral age requirement.

Executive Summary

The base case adopts the most certain, best known information available. While there are many uncertainties which have the potential to change the base case harvest forecast there are relatively few where this seems likely to occur. The two factors given the greatest chance of occurring: the adoption of site index adjustment procedures and genetic worth estimates have positive effects on timber supply. There is significant uncertainty about: (1) operability, (2) the effects of *Armillaria* root disease, and (3) the future age class distribution of the excluded productive forest. Further studies may provide better insight into these uncertainties, however the base case reflects the best available estimates of these parameters at the present time.

The socio-economic analysis for the Kootenay Lake TSA indicates that the current AAC of 700 000 cubic metres could support about 1,011 person-years of direct employment and 1,276 person-years of indirect and induced employment across the province.

The base case harvest forecast for the next five decades is 691 000 cubic metres per year, which reflects the current harvest level after accounting for 9000 cubic metres per year assigned to woodlot licences issued since the last determination. In the sixth decade, the base case harvest forecast declines by 10% to 622 000 cubic metres per year, followed by a further 3% reduction to a long-term level of 605 000 cubic metres per year by the seventh decade. This forecast would allow the industry to maintain its present level of operations in the short term and provide time to adjust to the lower long-term harvest level.

If fully harvested and utilized, the base case harvest forecast could generate an estimated $21.6 million in provincial government revenues annually.

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Introduction

Timber supply* is the quantity of timber available for harvest over time. Timber supply is dynamic, not only because trees naturally grow and die, but also because conditions that affect tree growth, and the social and economic factors that affect the availability of trees for harvest, change through time.

Assessing the timber supply involves considering physical, biological, social and economic factors for all forest resource values, not just for timber. Physical factors include the land features of the area under study as well as the physical characteristics of living organisms, especially trees. Biological factors include the growth and development of living organisms. Economic factors include the financial profitability of conducting forest operations, and the broader community and social aspects of managing the forest resource.

All of these factors are linked: the financial profitability of harvest operations depends upon the terrain, as well as the physical characteristics of the trees to be harvested. Determining the physical characteristics of trees in the future requires knowledge of their growth. Decisions about whether a stand is available for harvest often depend on how its harvest could affect the growth and development of another part of the forest resource, such as wildlife or a recreation area.

These factors are also subject to both uncertainty and different points of view. Financial profitability may change as world timber markets change. Unforeseen losses due to fire or pest infestations will alter the amount and value of timber. The appropriate balance of timber and non-timber values in a forest is an ongoing subject of debate, and is complicated by changes in social objectives over time.

Thus, before an estimate of timber supply is interpreted, the set of physical, biological and socio-economic conditions on which it is based, and which define current forest management — as well as the uncertainties affecting these conditions — must first be understood.

Timber supply analysis is the process of assessing and predicting the current and future timber supply for a management unit (a geographic area). For a timber supply area (TSA)*, the timber supply analysis forms part of the information used by the chief forester of British Columbia in determining an allowable annual cut (AAC)* — the permissible harvest level for the area.

Timber supply projections made for TSAs look far into the future — 250 years or more. However, because of the uncertainty surrounding the information and because forest management objectives change through time, these projections should not be viewed as static prescriptions that remain in place for that length of time. They remain relevant only as long as the information upon which they are based remains relevant. Thus, it is important that re-analysis occurs regularly, using new information and knowledge to update the timber supply picture. Indeed, the *Forest Act* requires that the timber supply for management units through out British Columbia be reviewed at least every 5 years. This allows close monitoring of the timber supply and of the implications for the AAC stemming from changes in management practices and objectives.

**Throughout this document, an asterisk after a word or phrase indicates that it is defined in a box at the foot of the page, as well as in the glossary.*

Timber supply
The amount of timber that is forecast to be available for harvesting over a specified time period, under a particular management regime.
Timber supply area (TSA)
An integrated resource management unit established in accordance with Section 7 *of the* Forest Act.

Allowable annual cut (AAC)
The rate of timber harvest permitted each year from a specified area of land, usually expressed as cubic metres of wood per year.

Introduction

Timber supply analysis involves three main steps. The first is collecting and preparing information and data. The B.C. Forest Service forest inventory* plays a major role in this. The second step is using this data along with a timber supply computer model or models* to make projections or estimates of possible harvest levels over time. These projections are made using different sets of assumed values or conditions for the factors discussed above. The third step is interpreting and reporting results.

Sections 1 through 6 of this report outline the timber supply analysis for the Kootenay Lake TSA. Following a brief description of the area in Section 1, data preparation and formulation of assumptions are discussed in Section 2. Analysis methodology and results are presented in Sections 3 and 4. Section 5 examines the sensitivity of the results to uncertainties in the data and assumptions used. This is followed by a summary and conclusions.

Appendix A contains further details about the data and assumptions used in this analysis.

As part of the timber supply review, information is gathered on the short- and long-term implications of alternative harvest levels, and the capabilities and requirements of existing and proposed processing facilities. The socio-economic analysis, presented in Section 7 provides information for the chief forester and the local community to better understand the potential magnitude of impacts on employment and government revenues associated with any proposed harvest level changes.

Forest inventory
An assessment of British Columbia's timber resources. It includes computerized maps, a database describing the location and nature of forest cover, including size, age, timber volume, and species composition, and a description of other forest values such as recreation and visual quality.

Model
An abstraction and simplification of reality constructed to help understand an actual system or problem. Forest managers and planners have made extensive use of models, such as maps, classification systems and yield projections, to help direct management activities.

1 Description of the Kootenay Lake Timber Supply Area

The Kootenay Lake Timber Supply Area (TSA) is located in southeastern British Columbia and covers approximately one million hectares of the Nelson Forest Region. The boundaries of the TSA are similar to those of the Kootenay Lake Forest District, which also includes several provincial parks (listed below). The TSA is administered by the forest district office located just east of Nelson.

The Kootenay Lake TSA is located in the Selkirk and Purcell mountain ranges and encompasses three major drainage* systems (Kootenay Lake, Duncan River and Lardeau River). To the north of the TSA is Glacier National Park and to the south is the Canada-U.S.A. border. West of the Kootenay Lake TSA is the Arrow TSA, and to the east are the Invermere and Cranbrook TSAs.

Forests in the Kootenay Lake TSA have the distinction of being among the most productive in the interior of the province. In addition, lower elevation forests have a wide diversity of tree species. Within the land base currently considered available for timber harvesting, Douglas-fir, western larch, Engelmann spruce, subalpine fir, lodgepole pine, western redcedar and western hemlock predominate, while western white pine, Ponderosa pine, whitebark pine, aspen, birch and cottonwood occur in smaller amounts.

The current allowable annual cut (AAC) in the Kootenay Lake TSA is 700 000 cubic metres. This level was set by the chief forester on March 10, 1995 and was a 22% reduction from the previous level of 900 000 cubic metres per year. About 50% of the total TSA land base is considered productive forest land managed by the Ministry of Forests (MoF) (approximately 613 300 hectares). Currently about 42% of that productive forest is considered available and suitable for harvesting (or 21% of the total TSA land base).

Significant changes in forest management that have occurred since the last timber supply review was completed include:

- implementation of the *Forest Practices Code (FPC)**;
- creation of new provincial parks (Goat Range, West Arm, Lockhart and Kianuko) and expansion of Kokanee Glacier Park and the Purcell Wilderness Conservancy under the *Kootenay-Boundary Land Use Plan (KBLUP)* in 1995;
- management direction from the *Kootenay-Boundary Land Use Plan Implementation Strategy* (1997);
- development of managed stand yield tables (MSYT) to estimate future yields from harvested areas;
- approval by the provincial government of the *Kootenay-Boundary Higher Level Plan (HLP)** in December of 2000.

The Kootenay Lake TSA is experiencing significant population growth, and its population of approximately 33,000 (1996 Census) is expected to have grown by 4.5% since the 1996 Census. Almost one-half of the population lives in the three largest centres of Nelson, Creston and Kaslo. The TSA includes many other smaller communities, both incorporated and unincorporated.

Drainage
The surface and sub-surface water derived within a clearly defined catchment area, usually bounded by ridges or other similar topographic features, encompassing part, most, or all of a watershed. The term is sometimes used to describe an operating area or location.

Forest Practices Code
Legislation, standards and guidebooks that govern forest practices and planning, with a focus on ensuring management for all forest values.
Higher level plans
Higher level plans establish the broader, strategic context for operational plans, providing objectives that determine the mix of forest resources to be managed in a given area.

1 Description of the Kootenay Lake Timber Supply Area

The forests of the Kootenay Lake TSA provide a wide range of forest land resources, including timber, water, minerals, forage, fisheries, wildlife, scenic landscapes and recreation opportunities. Both residents and tourists enjoy outdoor recreation activities such as hiking, camping, hunting, fishing, wildlife watching, boating, mountain-biking, snowmobiling, and ski touring. The TSA includes part or all of several parks, including Bugaboo Alpine Recreation Area, Purcell Wilderness Conservancy, and Kokanee Glacier, Lockhart, Kianuko, West Arm and Goat Range provincial parks. Numerous recreation trails and campsites are scattered throughout the TSA.

1.1 The environment

The Kootenay Lake TSA includes both moist and wet climatic regions, and is commonly referred to as part of the Interior Wet Belt. The moist climatic region covers most of the TSA, except for a wet region north of the Purcell Wilderness Conservancy. Varied ecological features and high species diversity contribute to the high biodiversity* values in this TSA. Four biogeoclimatic zones* and three ecosections occur in the Kootenay Lake TSA.

The Interior Cedar Hemlock (ICH) zone occupies valley bottoms and lower slopes to about 1400 metres. Four different subzones of the ICH occur in this TSA, reflecting differences in precipitation. They range from a drier subzone around the south end of Kootenay Lake where annual precipitation averages 70 cm to a wetter subzone in the Duncan Valley where annual precipitation averages 120 cm. In general, the ICH zone has wet, cool winters and warm, dry summers, and is the most productive forest zone in the interior of B.C. The ICH has a high diversity of tree species including western redcedar, western hemlock, grand fir, Engelmann spruce, subalpine fir, western larch, Douglas-fir, western white pine, western yew, Ponderosa pine and lodgepole pine.

The Montane Spruce (MS) zone is confined to middle elevations of certain drainages in the southeastern part of the TSA. The climate of this zone is continental, with cold winters and moderately short, warm summers. The dominant tree species are Engelmann spruce, subalpine fir and lodgepole pine.

The Engelmann Spruce-Subalpine Fir (ESSF) zone is the uppermost forested zone in the Kootenay Lake TSA, typically occurring at elevations between 1400 and 2500 metres (i.e., above the ICH or MS zones and below the Alpine Tundra zone). The ESSF zone has a relatively cold, moist and snowy continental climate. Growing seasons are cool and short, while winters are long and cold. Engelmann spruce and subalpine fir are the dominant climax tree species, while alpine larch and whitebark pine also occur. At the lower elevations of this zone, lodgepole pine, Douglas-fir, western hemlock and western redcedar can be found.

The Alpine Tundra (AT) zone occurs at elevations greater than 2250 metres, above the ESSF zone. The climate is cold, windy and snowy with a short, cool growing season. By definition this zone is treeless and the vegetation is dominated by shrubs, herbs, mosses and lichens. Much of the alpine landscape lacks vegetation and is the domain of rock, ice and snow.

Biodiversity (biological diversity)
The diversity of plants, animals and other living organisms in all their forms and levels of organization, including the diversity of genes, species and ecosystems, as well as the evolutionary and functional processes that link them.

Biogeoclimatic zones
A large geographic area with broadly homogeneous climate and similar dominant tree species.

1 Description of the Kootenay Lake Timber Supply Area

The diverse forests of the Kootenay Lake TSA support an abundance and wide variety of wildlife species. Large mammals include black bear, grizzly bear, moose, mule deer, white-tailed deer, cougars, elk, mountain goat, bighorn sheep and caribou. The TSA overlaps the range of one of the largest and most viable populations of mountain caribou in Canada. Mountain caribou require older forests for forage and security cover, as well as large unfragmented forests for seasonal migrations.

Seventy per cent of the bird species known to occur in B.C. and 62% of bird species that breed in the province are known to exist in the Kootenay Lake area. More than 20 varieties of birds are year-round residents of the TSA including golden eagles, grouse, woodpeckers, jays, magpies, ravens and English sparrows. The area also contains one of the highest breeding concentrations of ospreys in the world. The Creston flats area at the south end of Kootenay Lake is particularly rich in birdlife, given its location on the North American flyway. The Midge Creek Wildlife Management Area was established in 1997.

Under the *Forest Practices Code*, a process exists for identifying species at risk and designating wildlife habitat areas with specific management practices. The wildlife species that have been declared Identified Wildlife in the three ecosections of the Kootenay Lake Forest District are presented in Table 1. Each ecosection occupies about one-third of the district.

6

1 Description of the Kootenay Lake Timber Supply Area

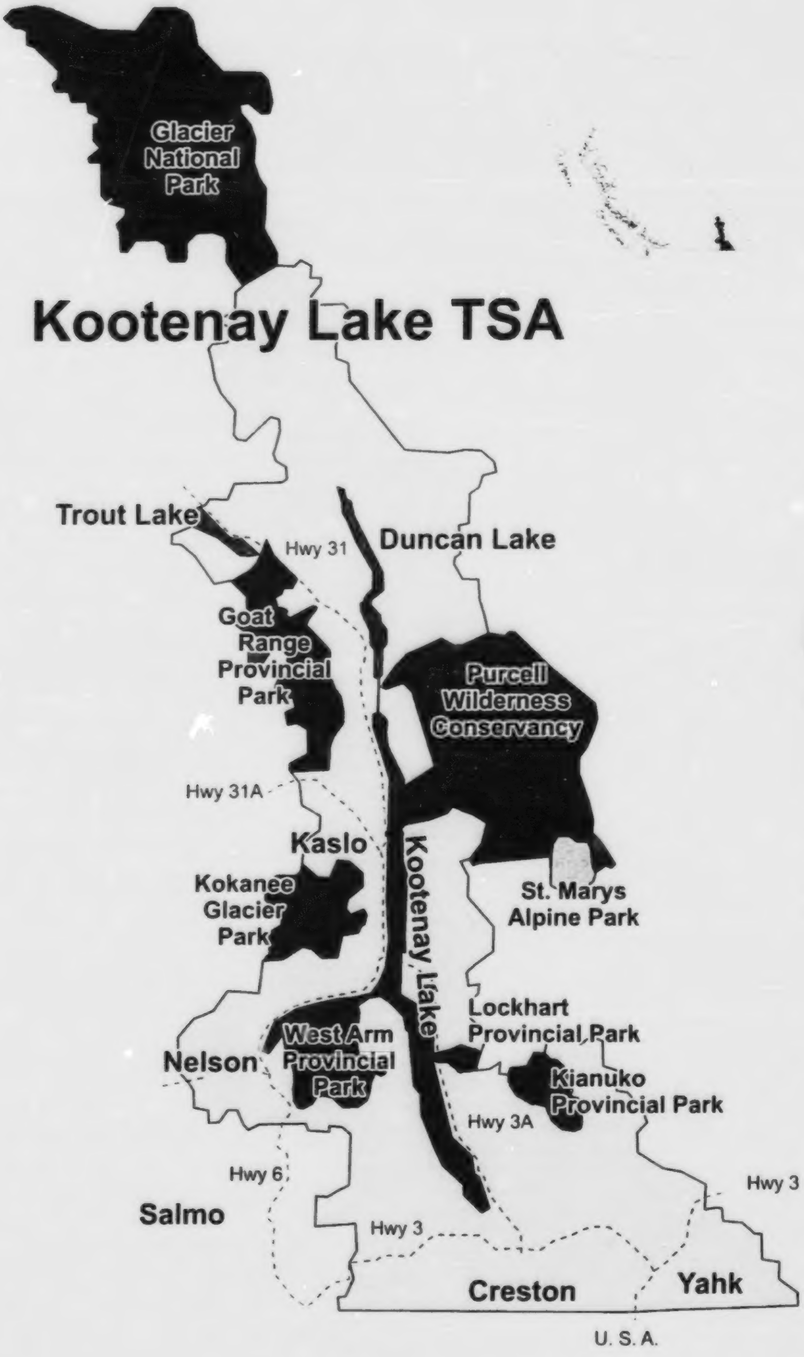

Glacier National Park
Kootenay Lake TSA
Trout Lake
Hwy 31
Duncan Lake
Goat Range Provincial Park
Purcell Wilderness Conservancy
N
Hwy 31A
Kaslo
Kootenay Lake
Kokanee Glacier Park
St. Marys Alpine Park
Lockhart Provincial Park
West Arm Provincial Park
Nelson
Kianuko Provincial Park
Hwy 3A
Hwy 6
Hwy 3
Salmo
Hwy 3
Creston
Yahk
U. S. A.

Figure 1. Map of the Kootenay Lake Timber Supply Area, Nelson Forest Region.

Table 1. Species at risk as listed under the Forest Practices Code

Common names of identified wildlife	Ecosection Central Columbia Mountains (CCM)	North Kootenay Mountains (NKM)	Southern Columbia Mountains (SCM)
Bull trout	x	x	x
Rubber boa	x		x
American bittern	x		x
Northern goshawk *atricapillus*	x	x	x
Prairie falcon			x
Lewis's woodpecker			x
Western grebe			x
Bobolink	x		x
Fisher	x	x	x
Grizzly bear	x	x	x
Mountain goat	x	x	x

Source: Managing Identified Wildlife: Procedures and Measures Volume 1, February 1999.

Water is a primary and fundamental resource of the Kootenay Lake TSA. Whether occurring as surface or groundwater, it is a crucial component of the ecosystems found in the area. The rivers and lakes of the TSA are home to numerous fish species including kokanee, rainbow trout, Gerrard trout, Westslope cutthroat, bull trout, whitefish, eastern brook trout, burbot and white sturgeon. As well, approximately 36% of the timber harvesting land base* is managed with a priority on protecting water quality and quantity for consumptive uses.

Timber harvesting land base
Crown forest land within the timber supply area where timber harvesting is considered both acceptable and economically feasible, given objectives for all relevant forest values, existing timber quality, market values and applicable technology.
Landscape unit
A planning area based on topographic or geographic features, that is appropriately sized (up to 100 000 hectares), and designed for application of landscape-level biodiversity objectives.

Current forest management practices follow the legislation and guidelines set out by the *Forest Practices Code*. Consequently, the protection of wildlife and the environment will be managed through the *Code*. In addition, the provincial government has adopted as policy the *Kootenay-Boundary Land Use Plan Implementation Strategy*. This has provided direction regarding landscape units (LU)*, biodiversity emphasis objectives, caribou habitat, ungulate* winter range (UWR), scenic corridors, community and domestic watersheds*, and forest cover constraints. In December 2000, the provincial government declared portions of the *Implementation Strategy* a *Higher Level Plan*, which means that compliance is mandatory by law.

Ungulate
A hoofed herbivore, such as deer.
Watershed
An area drained by a stream or river. A large watershed may contain several smaller watersheds.

1.2 First Nations

Three First Nations groups have identified traditional territories within the Kootenay Lake TSA: the Ktunaxa/Kinbasket, Shuswap and Okanagan. The Lower Kootenay Band (LKB) is a member band of the Ktunaxa/Kinbasket Tribe and is the only First Nations group with a reserve and/or community within the TSA. Located at Creston, the LKB has approximately 160 members. While the LKB's major revenue comes from land leases to local agricultural producers, the band council is pursuing economic diversification through traditional practices such as trapping, fishing, hunting and guiding, and botanical forest products. The LKB has a growing interest in forest management through ongoing consultation with Forest Service and forest industry staff. A number of LKB members are employed by local forest companies.

The Ktunaxa/Kinbasket First Nation has submitted a comprehensive land claim that covers the southeast corner of the province, including the Kootenay Lake TSA. Once the land claim has been finalized, it will be considered in future timber supply reviews. The Okanagan (other than the Westbank whose territory is not within the Kootenay Lake TSA), and the Shuswap are not involved in the treaty process.

A number of Archaeological Overview Assessments (AOA) have been completed in the Kootenay Lake Forest District, to ensure that areas with significant archaeological potential are examined prior to logging and road building. Field assessments (Archaeological Impact Assessments), when required, are conducted by qualified archaeologists as part of the Forest Development Planning process.

2 Information Preparation for the Timber Supply Analysis

Information required for timber supply analysis can be divided into three general categories: land base inventory; timber growth and yield; and management practices.

2.1 Land base inventory

Land base information used in this analysis came in a computer file compiled in 1998 by RHF Systems Limited of Kelowna, B.C. This file contains information on the forest land in the Kootenay Lake TSA including general geographic location, area, nature of forest cover (such as presence or absence of trees, species, number of trees, age, and timber volume), and other notable characteristics such as wildlife habitat areas and physical accessibility (operability*). Stand characteristics such as tree height, stocking* and age have been projected to January 1998. The inventory file has been updated to account for timber harvesting up to September 1997.

The inventory file represents the land base for the entire Kootenay Lake TSA. It includes information on land that does not contain forest, and other areas where timber harvesting is not expected to occur. Examples are land in parks, areas needed to protect wildlife habitat, and areas in power lines, highways, or town sites. A description of these areas specific to the Kootenay Lake TSA is provided below. These types of areas do not contribute to the timber supply of the Kootenay Lake TSA. Before assessing timber supply these non-contributing areas are identified and separated from the land base which represents the timber harvesting land base. When deriving this data file, care is taken to make only a single separation for areas with more than one characteristic that would make it unavailable for harvesting (for example, where a park area is also suitable for wildlife habitat). Identifying areas as not contributing to timber supply does not mean the area is also removed from the Kootenay Lake TSA. The B.C. Forest Service still manages the entire area of the TSA (except for designated areas under the jurisdiction of other agencies) as a land unit that contributes a mix of timber and non-timber values. The timber supply is managed within this integrated resource context, and the analysis described herein is consistent with this philosophy.

This section describes the types of areas not contributing to the timber harvesting land base. Use of the term timber harvesting land base in this report does not mean the area is open to unrestricted logging. Rather, it implies that forests in the area contain timber of sufficient economic value — and sites of adequate environmental resilience — to accommodate timber harvesting with due care for other resources.

Operability
Classification of an area considered available for timber harvesting. Operability is determined using the terrain characteristics of the area as well as the quality and quantity of timber on the area.

Stocking
The proportion of an area occupied by trees, measured by the degree to which the crowns of adjacent trees touch, and the number of trees per hectare.

2 Information Preparation for the Timber Supply Analysis

For the Kootenay Lake TSA analysis, the following types of areas were excluded from the timber harvesting land base:

- land not administered by the province of B.C. — this includes areas under federal government jurisdiction and private land;
- non-forest and non-productive forest areas — areas not occupied by productive forest cover (e.g., rock, swamp, alpine areas and water bodies);
- non-commercial cover areas — areas occupied by non-commercial tree or brush species;
- land not managed by the B.C. Forest Service for timber supply — areas managed by other Crown agencies (for example, parks and protected areas*) and forest land not administered as part of the TSA (for example woodlot licences*);
- sensitive terrain areas* — a portion of all areas mapped, or predicted to have, potential soil stability problems associated with timber harvesting or road construction;
- existing unclassified roads, trails and landings (RTL) — areas of forest land that have been removed from timber production due to access development and harvesting to date;
- inoperable — areas classified by the forest inventory as unavailable for harvest for terrain-related or economic reasons;
- uneconomic* — areas identified by district staff as uneconomic to access and harvest;
- problem forest types (PFT) — stands that are operable but contain non-merchantable or low quality timber;
- streamside, wetland and lakeside reserves — areas that provide protection for riparian* and stream ecosystems;
- environmentally sensitive areas (ESA)* — areas identified as too sensitive to harvest due to avalanche hazard, regeneration problems or recreation values;
- low timber productivity areas — areas occupied by forest with low timber growing potential;
- future logging roads — estimated losses of productive forest land resulting from future development. These areas are initially included in the timber harvesting land base, and are subsequently removed following the first harvest.

Protected area
A designation for areas of land and water set aside to protect natural heritage, cultural heritage or recreational values (may include national park, provincial park, or ecological reserve designations).
Woodlot licence
An agreement entered into under the Forest Act. *It allows for small-scale forestry to be practised in a described area (Crown and private) on a sustained yield basis.*
Sensitive terrain areas
Areas with moderate to high potential for landslide initiation during timber harvesting or road construction, which therefore require special forest practices to ensure adequate site protection.

Uneconomic areas
Areas defined as unavailable for harvest for economic or terrain-related reasons. Characteristics used in defining uneconomic areas include distance from processing facilities, existing roads, difficulty of road access, and availability of suitable timber. Areas considered uneconomic can change over time as a function of changing harvesting technology and economics.
Riparian area
Areas of land adjacent to wetlands or bodies of water such as swamps, streams, rivers or lakes.
Environmentally sensitive areas
Areas with significant non-timber values, fragile or unstable soils, impediments to establishing a new tree crop, or high risk of avalanches.

A more detailed description of these categories, including specific criteria for identification is located in Appendix A, "Description of Data Inputs and Assumptions for the Timber Supply Analysis." Table 2 summarizes the areas in each category and shows the total area of the timber harvesting land base. The column "Productive forest area" provides the total productive forest area managed by the B.C. Forest Service within each category. Because there is a high degree of overlap among land classification categories, the actual area deducted to arrive at the timber harvesting land base depends on when the reduction occurs in the sequence. The current timber harvesting land base estimate for the Kootenay Lake TSA is 257 850 hectares, which is 13.1% (or 39 028 hectares) smaller than the estimate made in the previous TSR. The long-term timber harvesting land base estimate of 250 570 hectares made in the present TSR is also smaller than the 1993 TSR estimate, but only by 8.4%. The smaller reduction in the long-term land base is the result of reduced estimates of future road requirements.

Table 2. Timber harvesting land base for the Kootenay Lake TSA

Classification	Productive forest area (hectares)	Area (hectares)	Per cent (%) of TSA area	Per cent (%) of productive forest area
Total Kootenay Lake TSA		**1 239 633**	**100.0**	
Not administered by the province of B.C.		135 997		
Non-forest and non-productive forest land		486 279		
Non-commercial cover[a]		4 059		
Crown managed productive forest[b]		**613 299**	**49.5**	**100.0**
Reductions to Crown managed productive forest				
Not managed for timber supply	107 075	107 075		
Low timber productivity	29 777	29 658		
Problem forest types	12 665	11 826		
Inoperable	192 445	165 452		
Uneconomic areas	7 633	1 813		
Sensitive terrain areas	39 722	17 142		
Environmentally sensitive areas	34 007	2 963		
Riparian management areas	14 904	10 687		
Existing unclassified roads, trails and landings	8 833	8 833		
Total current reductions		**355 449**	**28.7**	**58.0**
Current timber harvesting land base		**257 850**	**20.8**	**42.0**
Future reductions				
Logging roads, trails and landings		7 280	0.6	1.2
Long-term timber harvesting land base		**250 570**	**20.2**	**40.9**

(a) While areas of non-commercial brush and trees are classified by the B.C. Forest Inventory as 'productive forest', they are excluded from the productive forest estimates in the analysis to be consistent with the definition given in the *FPC Landscape Unit Planning Guide*.

(b) Crown managed productive forest excludes woodlots which are not administered as part of the TSA for AAC determination.

2 Information Preparation for the Timber Supply Analysis

Figure 2 shows the total Kootenay Lake TSA land base divided into, the area not managed by the province (e.g., federal land) plus non-productive forest land, the area that is Crown managed productive forest, but excluded from timber harvesting and the area determined to represent the current timber harvesting land base. The total area chart shows that the Crown managed timber harvesting land base is about 21% of the TSA land base.

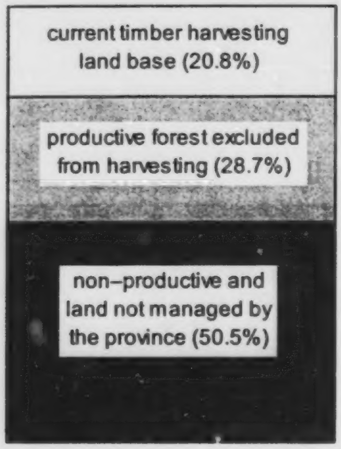


Figure 2. Components of the Kootenay Lake TSA land base, 2001.

Figure 3 shows the current composition of the timber harvesting land base by tree species group (For definitions of these groups please refer to Appendix A, Table A-3., "Analysis Unit Characteristics"). Figure 3 also shows the distribution of the area within each species group relative to the minimum harvestable age (MHA) (see Appendix A, Section 4.3 for details on the minimum harvestable age for each species). The cedar / hemlock species group has the largest proportion (71%) of stands above minimum harvestable age. In total, about 51% of the stands in the timber harvesting land base are older than the minimum harvestable age.

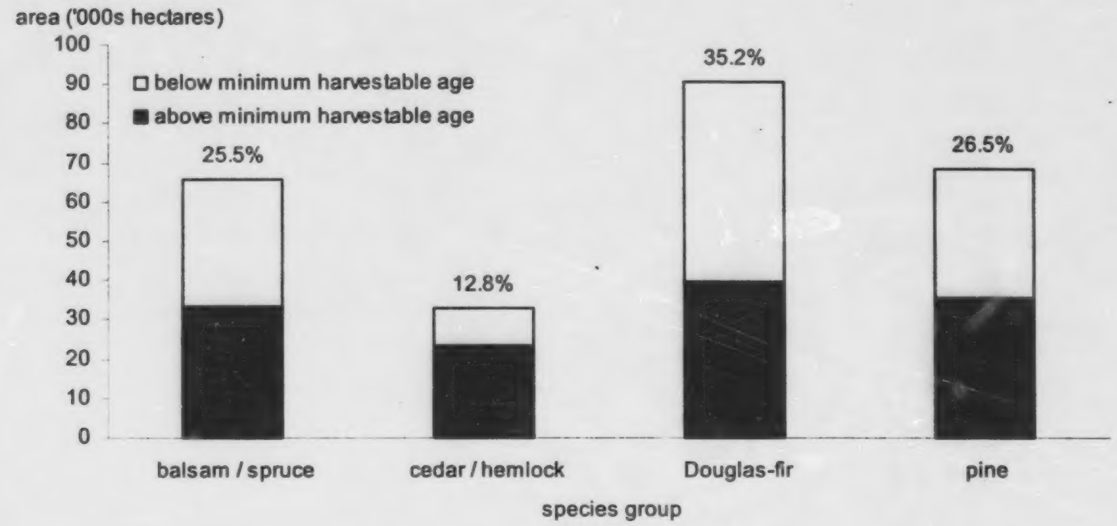


Figure 3. Area by tree species group and relative age — Kootenay Lake TSA timber harvesting land base, 2001.

Figure 4 provides an overview of the timber harvesting land base site productivity distribution by leading species group. The timber harvesting land base only includes stands with site indices of eight metres and greater. All stands within the timber harvesting land base were classified into three site productivity classes divided at 14 and 20 metres site index (SI)*. All site index values are in metre heights at 50 years of age. Over all species groups, 22% of the sites in the timber harvesting land base have site indices exceeding 20 metres, 55% are between 14 and 20 metres, and 23% are below 14 metres.

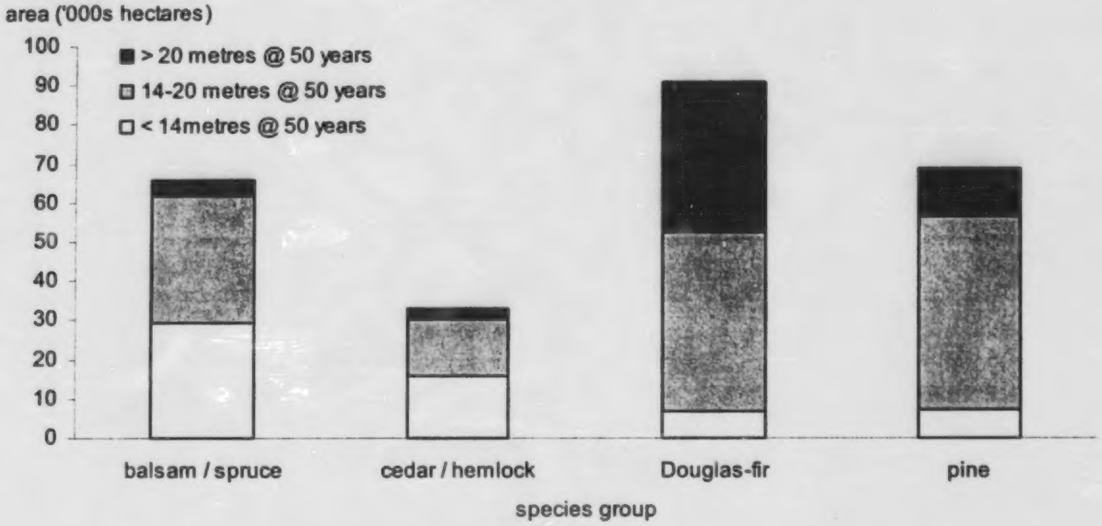


Figure 4. Area by tree species group and site productivity class — Kootenay Lake TSA timber harvesting land base, 2001.

Site index
A measure of site productivity. The indices are reported as the average height, in metres, that the tallest trees in a stand are expected to achieve at 50 years (age is measured at 1.3 metres above the ground). Site index curves have been developed for British Columbia's major commercial tree species.

Figure 5 shows the current age class distribution of the productive forest land base of the Kootenay Lake TSA (includes the area excluded from timber harvesting). Overall 32% of the productive forest area is 140 years or older, and 8% is 240 years or older. Within the timber harvesting land base, there is a preponderance of stands in the 60 to 130 year age range, and a low proportion of stands in the 40 to 50 year and the 140 to 220 year age ranges.

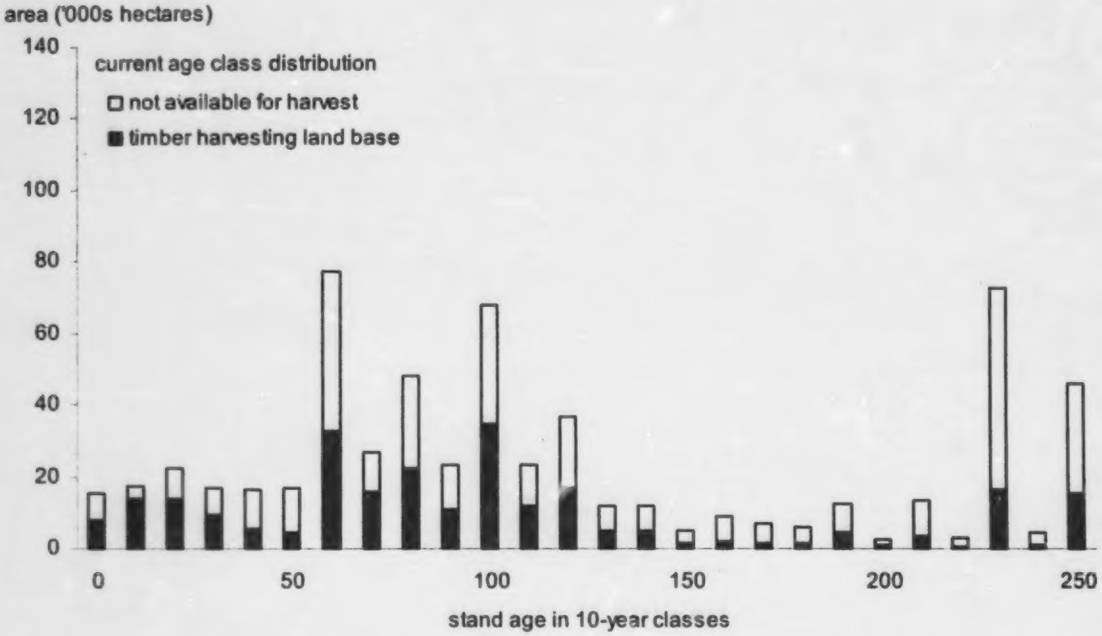
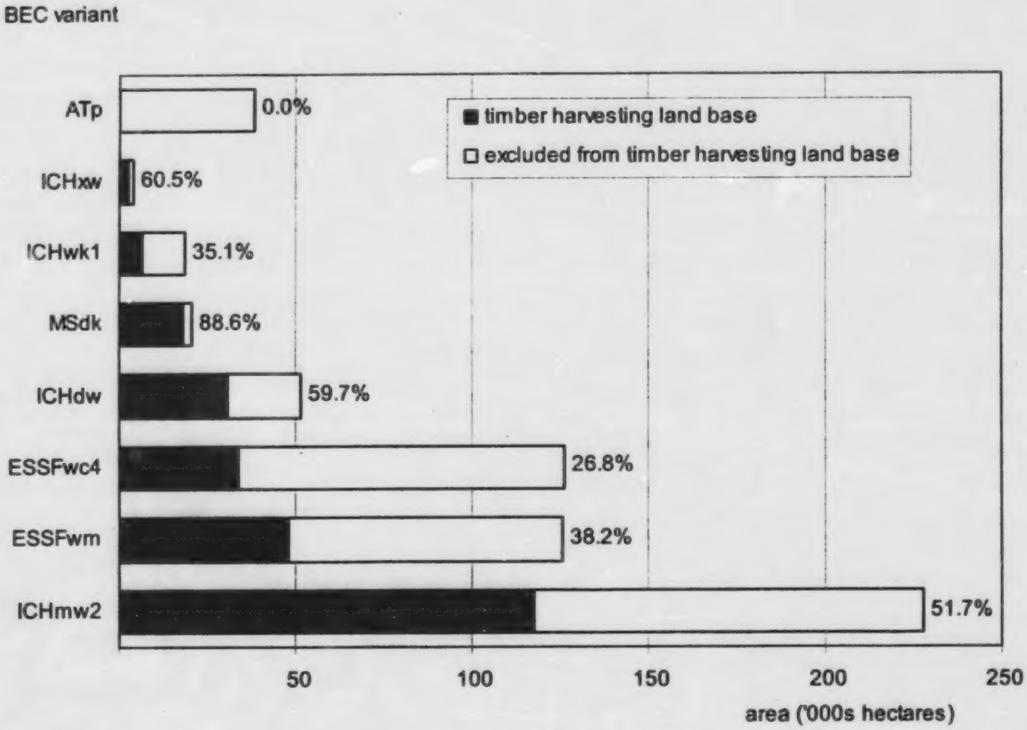


Figure 5. Current age class composition — Kootenay Lake TSA productive forest land base, 2001.

Figure 6 and Table 3 depict the distribution of productive forest under management within the Kootenay Lake TSA relative to the biogeoclimatic ecosystem classification (BEC) system. They also identify the portion of the productive forest within each BEC category subject to timber harvesting. This portion available for harvesting is significant because landscape-level biodiversity* requirements can be met by areas outside of the timber harvesting land base if there is a sufficient amount of suitable land base. Where there is an inadequate amount of area outside of the timber harvesting land base, timber supply is more heavily constrained to meet biodiversity objectives. Landscape-level biodiversity requirements are specified at the landscape unit geographic scale and vary with natural disturbance type (NDT)* and biogeoclimatic variant*.



Note: Percentages show proportion of variant's productive forest in timber harvesting land base.

Figure 6. Distribution of crown productive forest by biogeoclimatic variant — Kootenay Lake TSA, 2001.

Landscape-level biodiversity
The Landscape Unit Planning Guide *provides objectives for maintaining biodiversity at both the landscape level and the stand level. At the landscape level, guidelines are provided for the maintenance of seral stage distribution, patch size distribution and landscape connectivity.*
Natural disturbance type (NDT)
An area that is characterized by a natural disturbance regime, such as wildfires, which affects the natural distribution of seral stages. For example areas subject to less frequent stand-initiating disturbances usually have more older forests.

Biogeoclimatic (BEC) variant
A subdivision of a biogeoclimatic zone. Variants reflect further differences in regional climate and are generally recognized for areas slightly drier, wetter, snowier, warmer or colder than other areas in the subzone.

Table 3. Area of productive forest by biogeoclimatic ecosystem variant and timber harvesting land base — Kootenay Lake TSA, 2001

BEC variant	Crown productive forest (hectares)	Per cent (%) of TSA productive forest in variant	Timber harvesting land base (hectares)	Per cent (%) of TSA timber harvesting land base in variant	Per cent (%) of variant's productive forest subject to timber harvesting
ICHmw2	227 783	37.1	117 719	45.7	51.7
ESSFwm	125 900	20.5	48 124	18.7	38.2
ESSFwc4	126 359	20.6	33 870	13.1	26.8
ICHdw	51 695	8.4	30 865	12.0	59.7
MSdk	20 601	3.4	18 259	7.1	88.6
ICHwk1	18 781	3.1	6 599	2.6	35.1
ICHxw	3 940	0.6	2 385	0.9	60.5
ATp	38 134	6.2	0	0.0	0.0

2.2 Timber growth and yield

Timber growth and yield refers to the prediction of the growth and development of forest stands over time. Forest stands have many characteristics that change over time that could be the subject of growth and yield (for example, number of trees per area, tree diameter, tree height, species composition). Since timber supply analysis concentrates on timber volumes available over time, the most relevant measure for this analysis is volume per area (in British Columbia, cubic metres per hectare). Timber volume estimates* for a stand assume a specific utilization level or set of dimensions, that establish the minimum tree and log sizes that are removed from a site. Utilization levels used in estimating timber volumes specify minimum diameters both near the base and the top of a tree.

Two growth and yield models were used to estimate timber volumes for the Kootenay Lake TSA analysis. The variable density yield prediction (VDYP)* model developed by the B.C. Forest Service, Resources Inventory Branch, was used for estimating volumes in existing natural stands. The table interpolation program for stand yields (TIPSY)*, developed by the B.C. Forest Service, Research Branch was used to estimate yields for managed stands. All stands identified by the forest inventory with a silviculture treatment history, and all stands harvested in the future, are assumed to grow according to managed stands yield estimates from TIPSY.

Volume estimates (yield projections)
Estimates of yields from forest stands over time. Yield projections can be developed for stand volume, stand diameter or specific products, and for empirical (average stocking), normal (optimal stocking) or managed stands.

Variable Density Yield Prediction model
An empirical yield prediction system supported by the B.C. Forest Service, designed to predict average yields and provide forest inventory updates over large areas (i.e., Timber Supply Areas). It is intended for use in unmanaged natural stands of pure or mixed composition.

Table Interpolation Program for Stand Yields
A B.C. Forest Service computer program used to generate yield projections for managed stands using a model that simulates the growth of individual trees based on internal growth processes, crown competition, environmental factors and silvicultural practices.

Volume estimates and predictions are somewhat uncertain due to variability in inventories which form the basis for estimating site productivity, and to limited experience with second-growth in British Columbia. Sensitivity analyses described in Section 5, "Timber Supply Sensitivity Analyses," address the possibility that actual timber volumes may be different from estimates used in this analysis.

Based on timber volume estimates for existing stands, the current timber inventory on the timber harvesting land base is approximately 49 million cubic metres. About 41 million cubic metres, or 82% of this is volume, is found in stands older than minimum harvestable age.

2.3 Management practices

Timber supply depends on how the forest is managed for both timber and non-timber values. Therefore, levels of management activity must be defined for the timber supply analysis process. The focus of the timber supply review is to assess timber supply based on current management practices as implemented in plans for the area. Staff in the Kootenay Lake Forest District provided descriptions for the following management practices:

- Silviculture practices — reforestation and stand tending activities required to establish free-growing* stands of acceptable tree species.
- Forest health and unsalvaged losses* — unsalvaged timber losses on the timber harvesting land base due to insect attack, blowdown, fire and other natural agents are expected to average 30 965 cubic metres per year.
- Utilization levels — minimum sizes of trees, and logs to be removed during harvesting. Volume estimates are based on the utilization of all trees which meet or exceed the following standards: a minimum 10-centimetre top diameter; a maximum 30-centimetre high stump; and a minimum diameter of 17.5 centimetres at 1.3 metres above the ground, except for lodgepole pine for which the minimum diameter is 12.5 centimetres at 1.3 metres above the ground.
- Silvicultural systems — A variety of harvesting systems such as selection, shelterwood and variable retention partial harvests have been employed to a limited extent in the Kootenay Lake TSA. However, given the limited scope, uncertainties about growth and yield in partially cut stands, and the location and extent of future operations, only clearcut harvesting* was modelled in the analysis. Uncertainties about growth and yield in partial cuts, and the appropriate use of partial cutting to meet specified forest management objectives is a provincial issue being assessed by the B.C. Forest Service. As information on alternative systems becomes available it will be included in future timber supply reviews.

Free-growing
An established seedling of an acceptable commercial species that is free from growth-inhibiting brush, weed and excessive tree competition.
Unsalvaged losses
The volume of timber killed or damaged annually by natural causes (e.g., fire, wind, insects and disease) and not harvested.

Clearcut harvesting
A harvesting method in which all trees are removed from an area of land in a single harvest. The harvested site is then regenerated to acceptable standards by appropriate means including planting and natural seeding. Note that retention of some live trees and snags for purposes of biodiversity now occurs on most clearcuts.

- Minimum harvestable ages — define the time it takes for stands to grow to a merchantable condition. Minimum harvestable ages for this analysis were based on attaining a minimum merchantable volume and achievement of at least 95% of culmination mean annual increment*. The minimum harvestable age defines the youngest age at which a specific type of stand is expected to become harvestable. Actual harvest age in the model may be greater but not less than the minimum, and will depend on ages of other stands, forest cover objectives* (e.g., for caribou habitat, visual quality, community watersheds, ungulate winter range), and overall timber harvest targets.
- Cutblock adjacency* and visual resources — with some exceptions, district approval of harvesting activities is contingent on previously harvested stands reaching a desired condition, or green-up*, before adjacent stands may be harvested. To reflect these requirements cover objectives which specify the proportion of forest which can be below green-up were specified in all areas by either interim visual quality objectives (VQO)* or integrated resource management (IRM)* adjacency constraints. Within the IRM area — the maximum proportion that does not meet green-up conditions — trees at least two metres in height — cannot exceed 33%. Within the visually sensitive areas — the maximum area which can be below the green-up height specified by the slope of the area — is assigned according to the visual quality classification (see Appendix A, Section A.4.8 for details).
- Wildlife habitat — areas designated as ungulate winter range (UWR) or caribou habitat by the *Kootenay Boundary Land Use Plan* — are required to meet forest cover objectives which limit the amount of area which can be in a young forest condition, and the minimum area which must remain in a mature or old state.
- Protection of environmentally sensitive areas (ESAs) — areas where potentially unstable soils, avalanche tracks, recreation activities, and forest regeneration problems have been identified as highly significant, they have been fully excluded from the timber harvesting land base.
- Community and domestic watersheds — for modelling purposes, within community watersheds a recommended maximum of 25% of the area may be less than the green-up height of nine metres. Within Class 1, 2 and 3 domestic watersheds a maximum of 15%, 20% or 25% of the area may be less than the green-up height of six metres.

Mean annual increment (MAI)
Stand volume divided by stand age. The age at which average stand growth, or MAI, assumes its maximum is called the culmination age. Harvesting all stands at this age results in a maximum average harvest over the long term.
Forest cover objectives
Specify desired distributions of areas by age or size class groupings. These objectives can be used to reflect desired conditions for wildlife, watershed protection, visual quality and other integrated resource management objectives. General adjacency and green-up guidelines are also specified using forest cover objectives (see ***Cutblock adjacency and Green–up****).*
Cutblock adjacency
The desired spatial relationship among cutblocks. Most adjacency restrictions require that recently harvested areas must achieve a desired condition (green-up) before nearby or adjacent areas can be harvested. Specifications for the maximum allowable proportion of a forested landscape that does not meet green-up requirements are used to approximate the timber supply impacts of adjacency restrictions.

Green-up
The time needed after harvesting for a stand of trees to reach a desired condition (usually a specific height) — to ensure maintenance of water quality, wildlife habitat, soil stability or aesthetics — before harvesting is permitted in adjacent areas.
Visual quality objective (VQO)
Defines a level of acceptable landscape alteration resulting from timber harvesting and other activities. A number of visual quality classes have been defined on the basis of the maximum amount of alteration permitted.
Integrated resource management (IRM)
The identification and consideration of all resource values, including social, economic and environmental needs, in resource planning and decision-making.

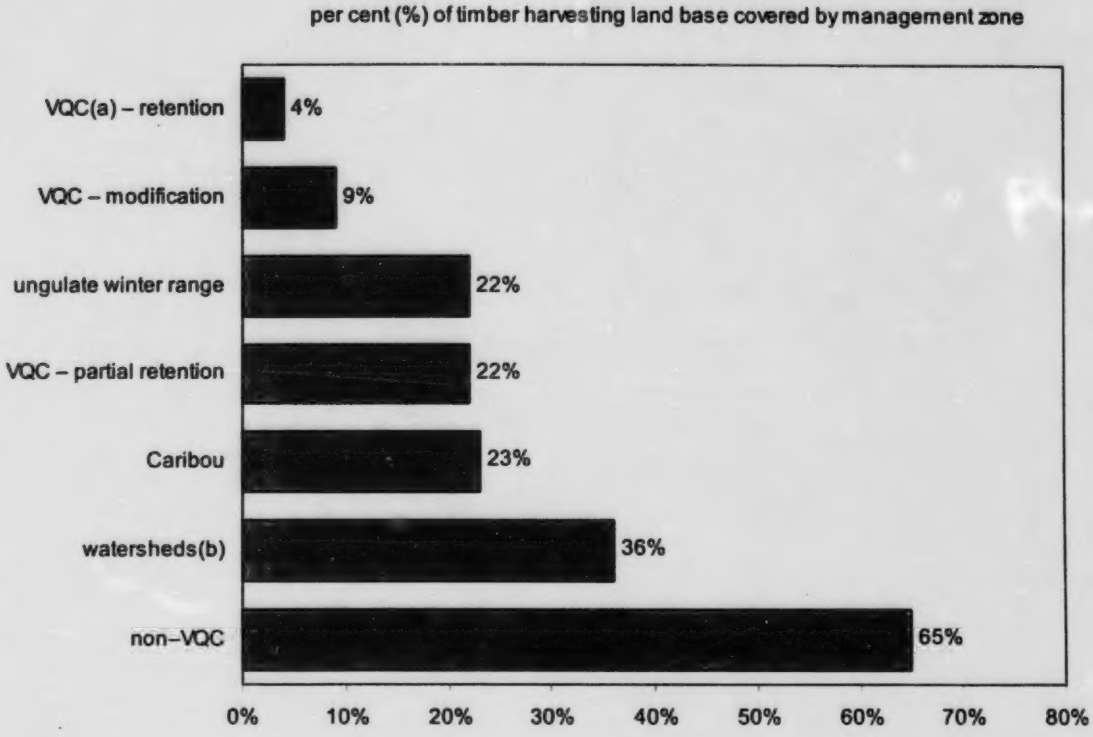
- Stand-level biodiversity* — to maintain biological diversity in forest stands, wildlife trees* and wildlife tree patches are retained after harvesting cutblocks*. In the Kootenay Lake TSA, retention of wildlife trees and patches are estimated to reduce stand-level timber yields by 2.2%.
- Landscape-level biodiversity — to maintain biological diversity throughout a landscape unit, forest cover requirements* establish the amount of area in the landscape unit that must be covered by stands with mature and old-forest characteristics. In the Kootenay Lake TSA, within each biogeoclimatic variant, a proportion of the forested area must be covered by stands older than 100, 120, 140 or 250 years, depending on the biogeoclimatic variant, NDT and seral requirement.

More detailed descriptions of these management practices and the assumptions used to assess their impacts on timber supply are included in Appendix A, Section A.4.

Stand-level biodiversity
A stand is a relatively localized and homogeneous land unit that can be managed using a single set of treatments. In stands, objectives for biodiversity are met by maintaining specified stand structure (wildlife trees or patches), vegetation species composition and coarse woody debris levels.
Wildlife tree
A standing live or dead tree with special characteristics that provide valuable habitat for conservation or enhancement of wildlife.

Cutblock
A specific area, with defined boundaries, authorized for harvest.
Forest cover requirements
Specify desired distributions of areas by age or size class groupings. These objectives can be used to reflect desired conditions for wildlife, watershed protection, visual quality and other integrated resource management objectives. General adjacency and green-up guidelines are also specified using forest cover objectives (see Cutblock adjacency and Green–up).

Figure 7 shows the extent of each resource emphasis management zone relative to the timber harvesting land base. The percentages total to more than 100% due to overlap between management emphasis areas. The amount of area subject to the management zone objective and the nature of the objective determine the influence each objective has on the timber supply of the TSA.



(a) VQC = Visual Quality Class.

(b) Watersheds include community and individual domestic water supplies.

Figure 7. Forest management emphasis — Kootenay Lake TSA timber harvesting land base, 2001.

2.3.1 Kootenay-Boundary higher level plan order

On June 29, 2000 government released a draft *Kootenay-Boundary Higher Level Plan Order*. The announcement detailed government's intention to establish a higher level plan under the *Forest Practices Code* to declare forestry-related components of the *Kootenay-Boundary Land Use Plan Implementation Strategy* as legal requirements. This plan order came into effect January 21, 2001. The following forestry components of the *Implementation Strategy*, were modelled in the base case analysis:

- Recognition of landscape unit boundaries and biodiversity-emphasis option assignments.
- Old-forest and mature forest retention targets.
- Green-up reductions with patch size increases.
- Establishment of scenic areas*.

Connectivity, fire-maintained ecosystems and streams within domestic watersheds were not included in the analysis because no information on implementation of these objectives was available. If information becomes available prior to the chief forester's AAC decision it will be considered in the determination.

Scenic area
Any visually sensitive area or scenic landscape identified through a visual landscape inventory or planning process carried out or approved by a district manager.

3 Timber Supply Analysis Methods

The purpose of this analysis is to examine both the short- and long-term timber harvesting opportunities in the Kootenay Lake TSA, under current forest management practices. A timber supply computer simulation model developed by the B.C. Forest Service was used to aid in the assessment (FSSIM version 3.0). A timber supply model, as distinct from a growth and yield model, assists the timber supply analyst in determining how a forest could be managed to obtain a harvest forecast* (supply of timber over time). The simulation model uses information about the timber harvesting land base, timber volumes, and the management regime to represent how trees grow and are harvested over a long period of time. Generally, only the results for the first 250 years are shown graphically in this report because the harvest level remains constant after that time.

Similar to other models, the B.C. Forest Service model assumes that trees grow according to provided yield projections and are harvested according to either a volume target or a specified objective set by the analyst, such as harvest volume maximization. The Forest Service model also allows the use of forest cover guidelines that specify the desired age composition of the forest. These guidelines can be used to examine the effects of cutblock adjacency and green-up prescriptions. For example, guidelines might specify that no more than some maximum percentage of the forest can be younger than a specified green-up age, or that some minimum percentage of the forest must be in older age classes to provide wildlife habitat. The B.C. Forest Service simulation model facilitates examination of the effects of such guidelines on timber supply.

This type of analysis is used to determine the timber supply implications of a particular timber harvesting regime. The results of the analysis are especially important in determining allowable cuts that will not restrict options of future resource managers, and that will assist local B.C. Forest Service staff to administer their programs according to relevant guidelines and principles. However, the results of the analysis are not meant to be taken as recommendations of any particular AAC.

The main results of the analysis are forecasts of potential timber harvests and timber inventory changes (ages and volumes) over time. Although this information gives field staff only limited guidance in the design of operational activities such as harvesting block location and silviculture planning, it does help ensure that the timber harvest level supports rather than hinders sustainable forest management in the field.

Harvest forecast
The flow of potential timber harvests over time. A harvest forecast is usually a measure of the maximum timber supply that can be realized over time for a specified land base and set of management practices. It is a result of forest planning models and is affected by the size and productivity of the land base, the current growing stock, and management objectives, constraints and assumptions.

4 Results

This section presents results of the timber supply analysis for the Kootenay Lake TSA. The forecasts presented in this section are based on the most recent assessments of current forest management, the land available for timber harvesting, and timber yields as described in Section 2, "Information Preparation for the Timber Supply Analysis." Uncertainty surrounds much of the information important in determining timber supply because of the long-term nature of forest management, as well as ongoing planning processes that may lead to changes in land use and management strategies. These uncertainties will be discussed in Section 5, "Timber Supply Sensitivity Analyses." The results presented below provide only a part of the timber supply picture for the Kootenay Lake TSA, and should not be viewed in isolation of the sensitivity analysis*.

Unsalvaged losses to natural forces such as insects and fire are estimated to be 30 965 cubic metres per year for the entire 250-year period examined in this analysis, and have been subtracted from all the harvest forecasts shown in this report.

4.1 Harvest forecasts

Figure 8 presents both the current base case forecast and the previous timber supply review base case forecast prepared in 1993. The current base case forecast maintains an initial harvest level of 691 000 cubic metres, which is equivalent to the current AAC (minus recently issued or expanded woodlots) for 50 years, and then falls by 10% to 622 000 cubic metres for one decade, and then by 3% to a long-term harvest level (LTHL)* of 605 000 cubic metres.

As shown in Figure 8, the long-term harvest level estimated in this analysis is 23% higher than the long-term harvest level estimated in 1993. Some of this increase results from a reduction in unsalvaged loss estimates, increases in managed stand yields, and reductions in the age of harvest. The initial harvest level is also sustained for a longer period of time, five decades, *versus* two in the 1993 analysis. This extension in initial harvest level is in part facilitated by an initial harvest level which is almost 14% below the 1993 initial harvest level combined with the previously mentioned reductions in unsalvaged losses and age of harvest.

The initial harvest level is 13.6% below the level in TSR 1, reflecting a reduction in AAC made in the 1995 determination and the accounting for approximately 9000 cubic metres of AAC for new and expanded woodlots.

The reduction in unsalvaged loss estimates, from the 1993 TSR estimate of 67 935 cubic metres per year, to the current 30 965 cubic metres per year primarily reflects reductions in insect and disease estimates. Much of the difference is attributable to a reduction in the estimate of losses to root rots. Some root rot losses are also included in an adjustment to regenerated yields, however, the overall effect is a substantial reduction in the estimated volume lost to root rots. The best available information was used to develop the unsalvaged loss estimate for this analysis; however, this issue is subject to uncertainty. See Section 5.3, "Uncertainty in volume reductions caused by root rot in regenerated stands" for more information on the potential effect of these uncertainties. Work is ongoing in the Nelson Forest Region to improve information on root rot dynamics and impacts on timber growth and yield. The increase in managed stand yields reflects adoption of the Table Interpolated Stand Yield (TIPSY) model which more accurately reflects yields of managed stands. The reduction in age of harvest is discussed in more detail in Section 4.2, "Statistics pertaining to the base case forecast."

Sensitivity analysis
A process used to examine how uncertainties about data and management practices could affect timber supply. Inputs to an analysis are changed, and the results are compared to a baseline or base case.

Long-term harvest level
A harvest level that can be maintained indefinitely given a particular forest management regime (which defines the timber harvesting land base, and objectives and guidelines for non-timber values) and estimates of timber growth and yield.

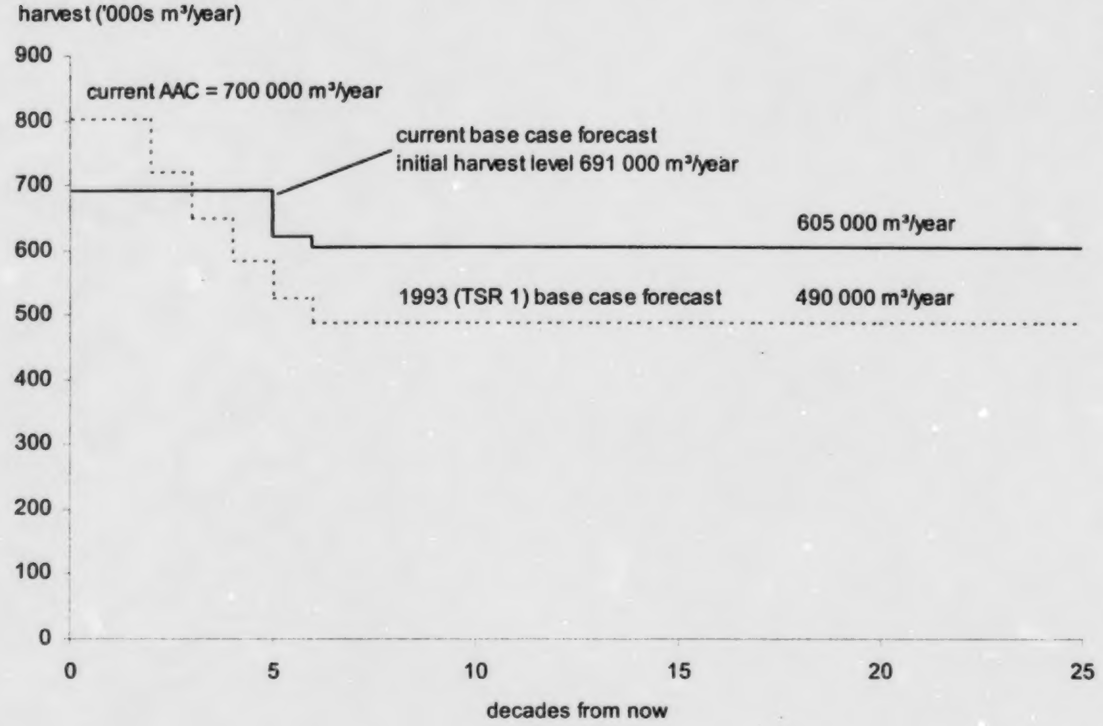


Figure 8. Current and 1993 (TSR1) base case harvest forecasts for the Kootenay Lake TSA, 2001.

The long-term harvest level was defined as the maximum harvest rate at which the growing stock* on the timber harvesting land base is sustained. A continually declining growing stock would signify that timber is being harvested above the productive capability of the land.

Growing stock
The volume estimate for all standing timber at a particular time.

4 Results

Figure 9 shows the growing stock for the base case harvest forecast* over time. As existing mature stands are harvested and replaced with younger stands, the total growing stock on the timber harvesting land base declines. Over the long term, the growing stock on the timber harvesting land base averages about 36 million cubic metres, 65% of which is maintained in stands above minimum harvestable ages.

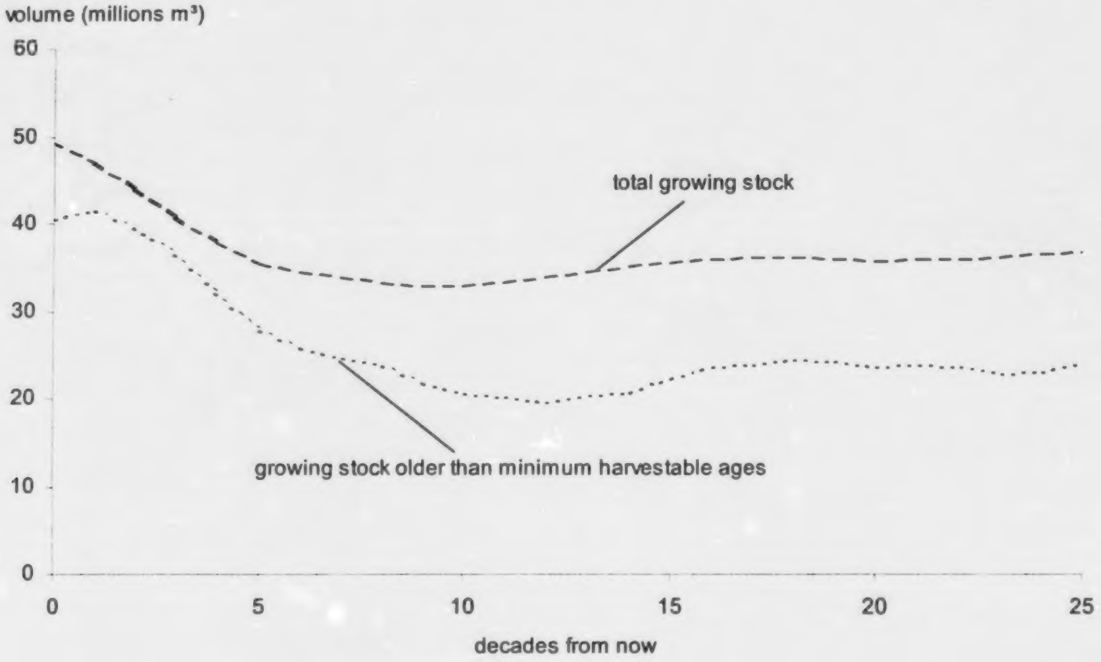


Figure 9. Timber harvesting land base growing stock forecasts — Kootenay Lake TSA base case, 2001.

Base case harvest forecast
The timber supply forecast which illustrates the effect of current forest management practices on the timber supply using the best available information, and which forms the reference point for sensitivity analysis.

4 Results

Figure 10 shows the portion of the base case harvest forecast volume that is contributed by managed stands. More than 95% of the harvested volume is obtained from managed stands by the sixteenth decade. The graduated conversion to managed stands results from management zones with more restrictive cover constraints (e.g., retention*, partial retention VQO*), the older minimum harvestable ages of lower productivity stands (initially 11% of the timber harvesting land base is subject to minimum harvestable ages greater than 130 years) and the random harvesting queuing rule.

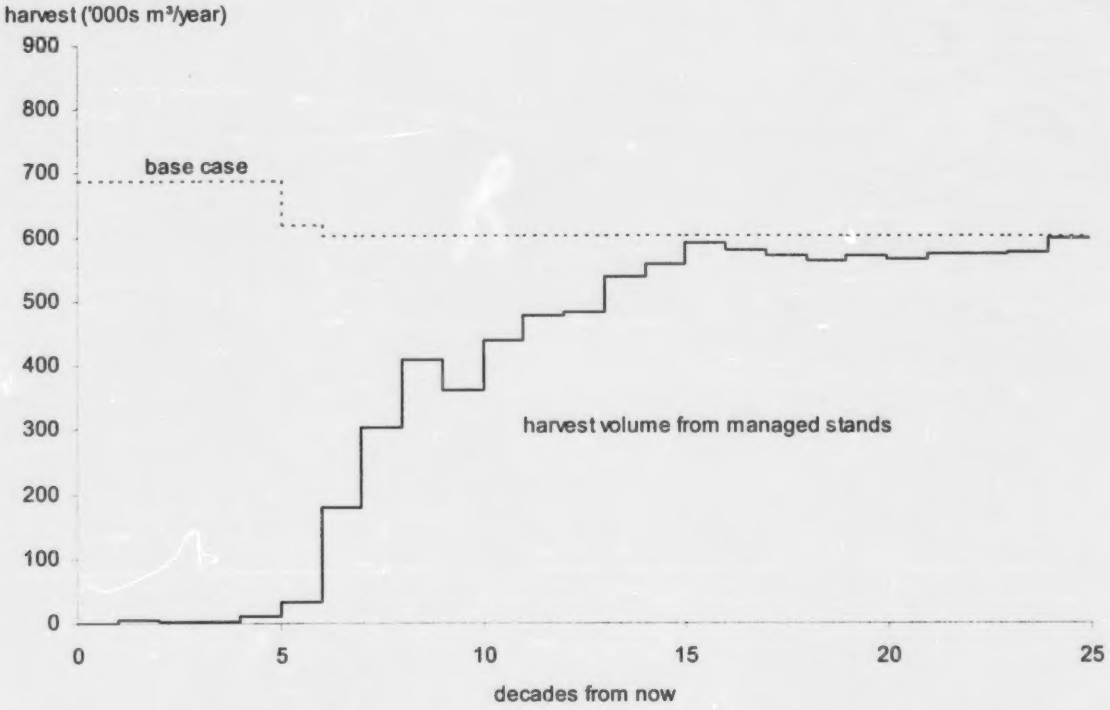


Figure 10. Harvest contributions from managed stands — Kootenay Lake TSA base case, 2001.

Retention VQO
*Alterations are not easy to see. Up to 5% of the visible landscape can be altered by harvesting activity (see **Visual quality objective**).*

Partial retention VQO
*Alterations may be visible but not conspicuous. Up to 15% of the area can be visibly altered by harvesting activity (see **Visual quality objective**).*

4.2 Statistics pertaining to the base case harvest forecast

Figure 11 shows average annual area harvested (hectares), and the average volume yield (cubic metres per hectare) by decade over the 250 years of the base case forecast. The area harvested is projected to average 2381 hectares per year, ranging from a maximum of 2680 hectares per year in the second decade, to a minimum of 2206 hectares per year in decade 12. The average volume yield of 275 cubic metres per hectare, ranges from a peak of 306 cubic metres per hectare in the fifth decade to a low of 246 cubic metres per hectare in decade 8.

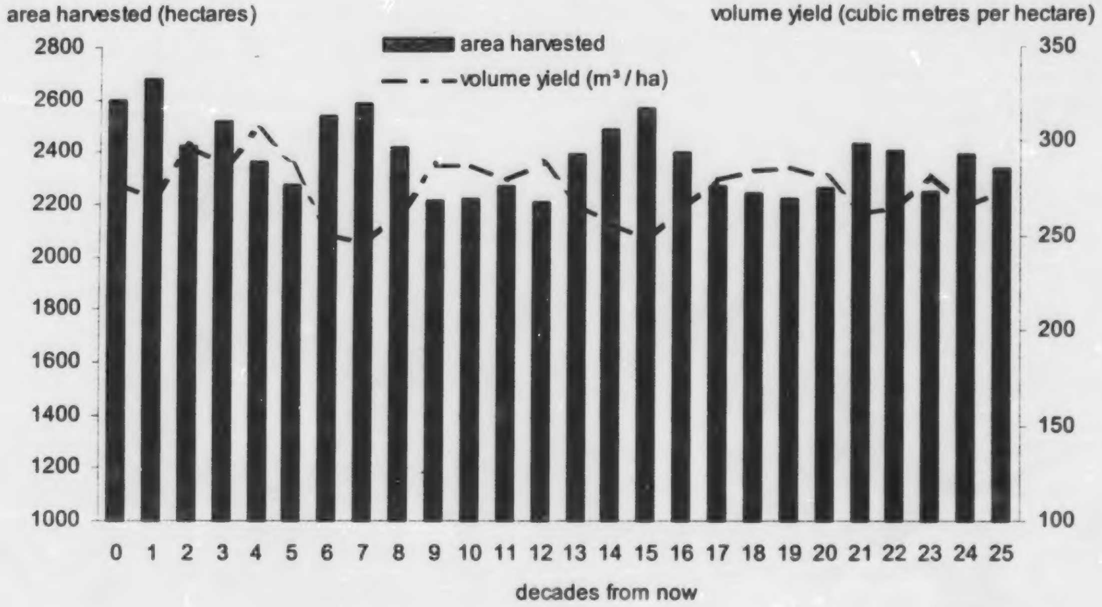


Figure 11. Average annual area harvested and volume yield— Kootenay Lake TSA base case, 2001.

4 Results

Figure 12 illustrates the projected average harvest age of the Kootenay Lake TSA for the base case harvest forecast. The change from older average harvest ages in the first six decades to younger average harvest ages coincides with replacement of existing older stands with managed stands. By the eighth decade, when more than half the total volume harvested is coming from managed stands, the long-term average harvest age stabilizes around 106 years. Constraints in some of the more restrictive management zones influence harvesting rates and effectively raise average harvest age. For example, average harvest ages in the long term for areas of partial retention visual quality class and caribou habitat are greater than the overall average by 15 and 67 years respectively. Forecast average harvest ages are reduced from the values estimated in the 1993 analysis. In 1993 the long-term average harvest age was estimated to be 175 years, or 69 years older than the present analysis. This reduction in average harvest age results from the use of different harvest queuing methods (random *versus* oldest first), different cover constraints and their implementation and to a minor extent decreases in regeneration delay* and minimum harvestable ages.

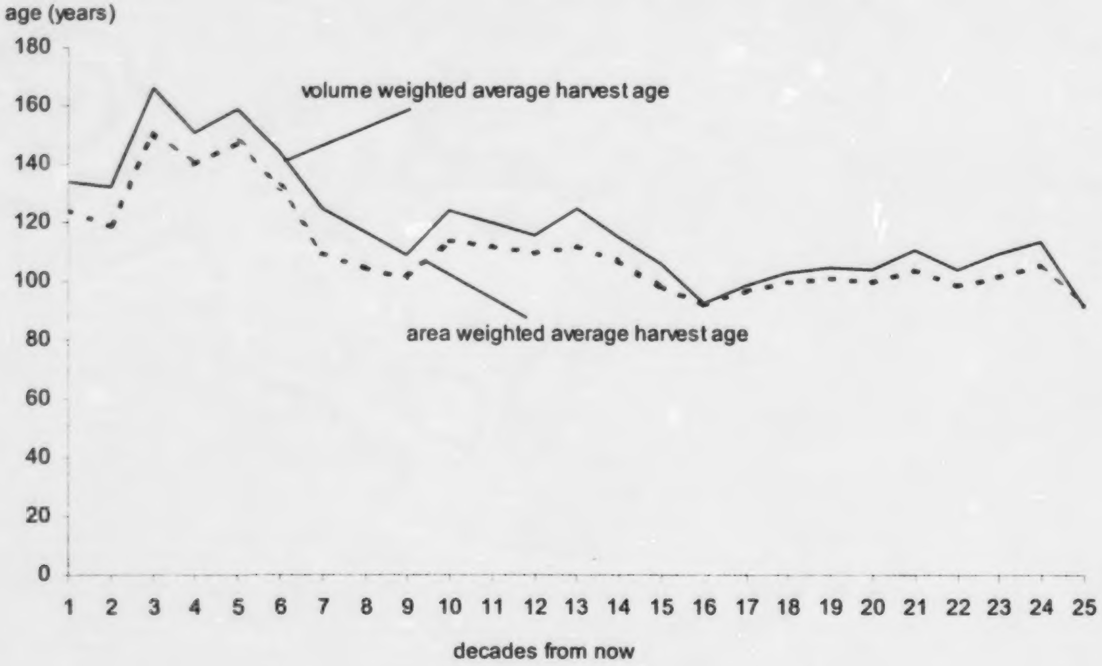


Figure 12. Average area weighted harvest age by decade for the Kootenay Lake TSA base case, 2001.

Regeneration delay
The period of time between harvesting and the date at which an area is occupied by a specified minimum number of acceptable well-spaced trees.

4.3 Age class composition over time

The charts in Figures 13 show how the age composition of the Crown productive forest within the Kootenay Lake TSA would change over the next 150 years under the base case harvest forecast. The shaded and unshaded portions of each bar in the chart indicate the portion of productive forest within and excluded from the timber harvesting land base. Starting with an almost equally balanced distribution between the timber harvesting land base and excluded area in each age class, the trend over time is to a uniform age distribution within the timber harvesting land base and an old, undisturbed forest in the excluded area. Although, the analysis assumes some losses from fire, insects and diseases, this is not reflected in the simulation of age class progression. Hence, the projected accumulation of the excluded area in the oldest age classes.

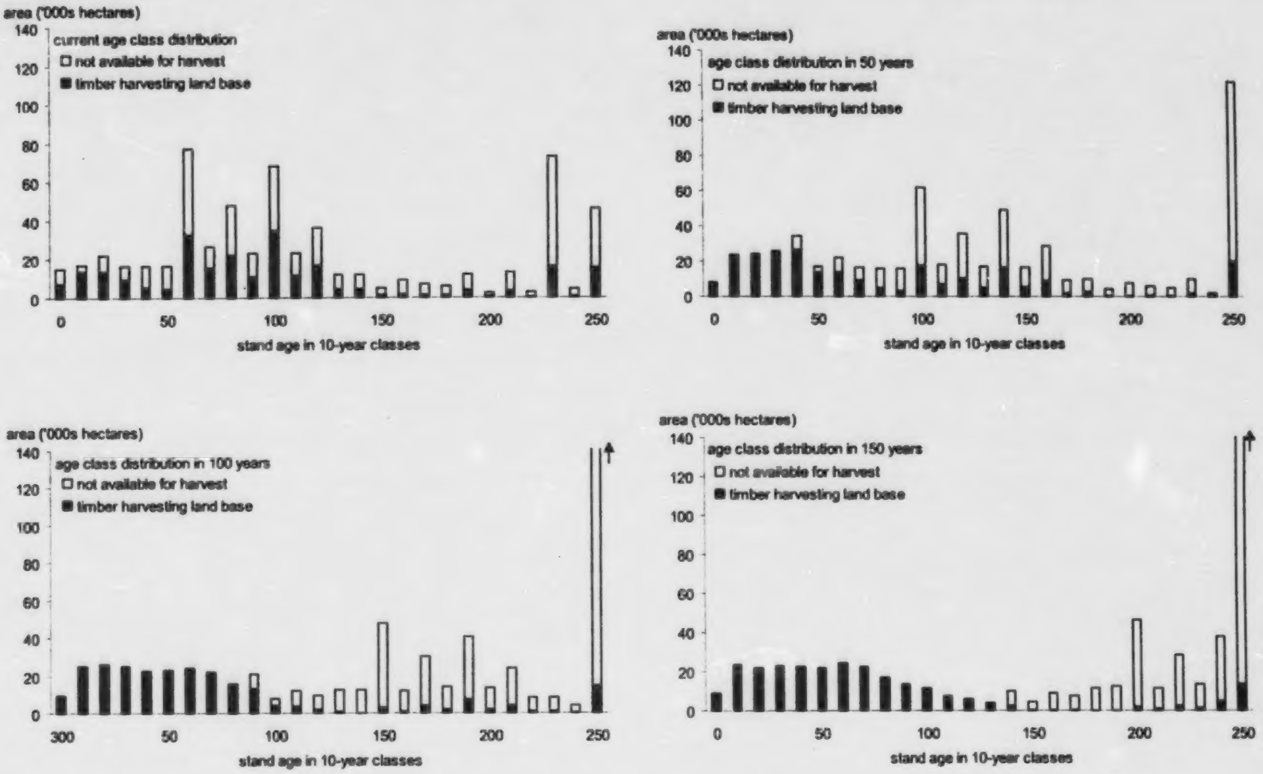


Figure 13. Changes in age composition on the Crown productive forest — Kootenay Lake TSA base case, 2001.

5 Timber Supply Sensitivity Analyses

The best available information on forest inventories and management practices is used to analyse the timber supply implications of continuing with current management. However, forest management is a complicated endeavor that must account for diverse and changing human values, the dynamics of complex ecosystems, and fluctuating and uncertain economic factors. As well, forests grow quite slowly in terms of human life spans, which means that decisions we make today have not only short-term but also long-term effects. In such a context, we cannot be certain that all data accurately reflect the current state of all values in the forest, how the forest will change, or how our management activities will affect the forest.

One important way to deal with this uncertainty is to revise plans and analyses frequently to ensure they incorporate up-to-date information and knowledge. Frequent planning and decision-making can help minimize any negative effects that may occur if decisions are based on inaccurate information. Frequent revision can also ensure that opportunities that become apparent from new information are not missed.

Another important way of dealing with uncertainty is to assess how values of interest, for example, timber supply, could change if the information used in the analysis is not accurate. Sensitivity analysis is one way of evaluating how uncertainty could affect analysis results, and ultimately decision-making. Sensitivity analysis can highlight that fairly small uncertainties about some variables could have large effects on timber supply projections, or conversely that fairly large inaccuracies in others could have negligible effects. Also, sensitivity analysis could show that some variables affect timber supply more in the short term than in the long term, while others have the opposite effect. Sensitivity analysis can highlight priorities for collecting information for future analyses, and show which variables, and associated uncertainties, have the most significance for decisions. It can clarify whether current best estimates provide safe basis for decisions, or whether high uncertainty about important variables means more conservative decisions may be wiser.

In this section, results of several sensitivity analyses are discussed. Sensitivity analyses are intended primarily to test the relative change (i.e., high *versus* low sensitivity) in the harvest forecast resulting from changes in forest management assumptions* and data used in the base case.

Management assumptions
Approximations of management objectives, priorities, constraints and other conditions needed to represent forest management actions in a forest planning model. These include, for example, the criteria for determining the timber harvesting land base, the specification of minimum harvestable ages, utilization levels, integrated resource guidelines and silviculture and pest management programs.

5.1 Alternative harvest flows

Figure 14 shows alternative harvest projections based on the current land base, growth and yield and management information used for base case AAC forecasts. The highest non-declining, sustainable harvest forecast attainable is 605 000 cubic metres per year, which is 14% below the base case initial harvest level. As shown in Figure 14 prolonging the initial harvest level by one decade results in a shortage of available timber in the eleventh decade. Because most of the forest cover objectives have not reached their maximum thresholds in the short term and there is ample mature growing stock at the outset of the simulation, it would be possible to increase the short-term harvest level above the initial harvest level of 691 000 cubic metres per year shown in Figure 14. An increase in the short-term harvest levels could not be sustained for more than a few decades, and would require a more rapid decline to the the long-term level, or a drop below the long-term harvest level in the mid-term.

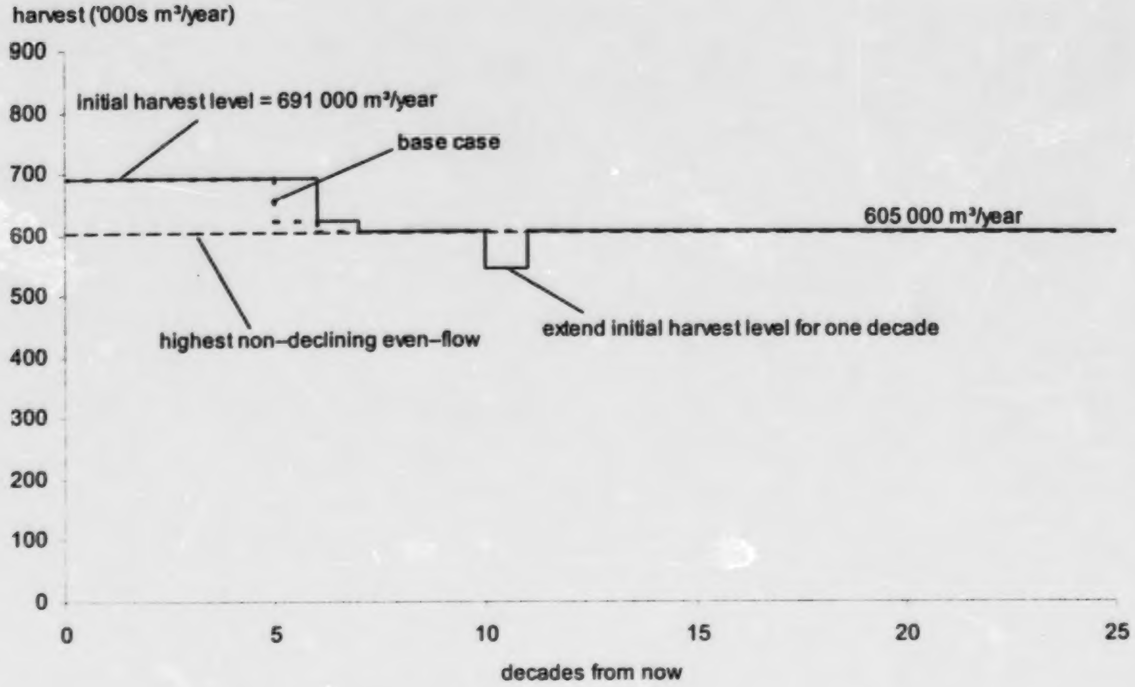


Figure 14. Alternative harvest forecasts using base case assumptions — Kootenay Lake TSA, 2001.

5.2 Uncertainty in the productivity of current old-growth sites after harvest and the application of genetic gains

The productivity of a site largely determines how quickly trees will grow. It therefore affects the timber volumes in regenerated stands, the time to reach green-up and the age at which stands will reach merchantable size. The most accurate estimates of site productivity come from stands between 30 and 150 years old. At ages less than about 30 years a temporary increase or decrease in growth due to factors such as post-harvest flush of nutrients or an unusual drought year can affect the overall productivity estimated for the stand. At older ages, site productivity estimates may be incorrect because tree heights do not represent actual production — for example due to top breakage — and it is very difficult to determine ages of old trees accurately. The results of recent province-wide research suggest that the estimated productivity of sites currently occupied by old-growth stands may be significantly underestimated. Two Old Growth Site Index (OGSI) studies of importance to timber supply forecasting are:

- *Site index adjustments for old-growth stands based on paired plots* (Nussbaum 1998). Data were obtained from paired plots installed in old-growth stands and adjacent logged stands of the same productivity. Site index was estimated for both and comparisons were made. Results are available for coastal Douglas-fir, lodgepole pine, and interior spruce.
- *Site index adjustments for old-growth stands based on veteran trees* (Nigh 1998). The objective of the study was to develop site index adjustments for species not covered by the paired-plot project. The data for this study came from temporary and permanent plots with a veteran and main stand component. The site indices for the two components were estimated and an adjustment equation for each species was derived using linear regression analysis. The results of the veteran study are considered less reliable than those from the paired-plot study.

5 Timber Supply Sensitivity Analyses

The results of these studies apply only to stands older than 140 years, which comprise 19% of the Kootenay Lake TSA timber harvesting land base. The paired plot results were applied to stands dominated by pine and spruce while the veteran study was applied to stands dominated by hemlock, cedar, balsam, Douglas-fir or larch. Timber supply analysis parameters affected by changes in estimated future productivity (managed stand volume estimates, green-up ages and minimum harvestable age) were recalculated based on average site productivity.

Results of the OGSI sensitivity analysis are presented in Figure 15. The graph shows that the long-term harvest level could be 11% higher, and the initial harvest level could be sustained an additional two decades beyond the base case forecast given these adjustments. Site index adjustments were not included in the base case forecast as current best available information because there is little local site productivity data or long-term monitoring of regenerated stands to support the adjustments. However, the results of the sensitivity analysis provide insight into the possible trends associated with site productivity estimates for the Kootenay Lake TSA and indicate that long-term timber supply is likely higher than estimated in the base case forecast.

Reforestation following harvesting is required by law in British Columbia and reforesting with selected orchard seedlings (if available) is a requirement of the *Forest Practices Code*. For the past 40 years the province has been selecting and breeding trees with desirable traits such as faster growth, better stem and wood quality, and resistance to diseases and insect attack. Tree breeding offers potential gains in timber supply through increases in growth rate that may reduce minimum harvestable ages, increase volume at time of harvest, and ease adjacency constraints through faster green-up. Improved seed produced from the tree improvement program can be obtained from seed orchards located throughout the province.

In this sensitivity analysis, genetic gain estimates forecast to come from seed provided by local, ecologically appropriate, orchards were applied. These estimates reflect expected genetic gain (genetic worth) of stock from these orchards as of the year 2008. These estimates reflect the current breeding cycle, and subsequent breeding cycles may increase the available genetic gain from improved seed. The 2008 estimates of genetic gain from the orchards were adjusted to account for seed production and availability, seed use, and rates of natural infill.

This sensitivity analysis assumes that all existing and future managed stands with improved tree species realize genetic gain values forecast for 2008. This somewhat overstates the genetic gain of existing stands because many of them were planted with wild seed, and the gain of the improved seed in existing stands is not as high as it will be by 2008. The sensitivity analysis also understates the impact of genetic gain on timber supply because it only reflects improvements in volume growth. Increases in height growth rates which would reduce green-up age estimates were not modelled. The sensitivity analysis may also understate further improvements in genetic gain from future breeding cycles.

5 Timber Supply Sensitivity Analyses

As shown in Figure 15, the adoption of the 2008 genetic gain values makes it possible to maintain the initial harvest level for one decade, and increase the long-term harvest level by approximately 3%.

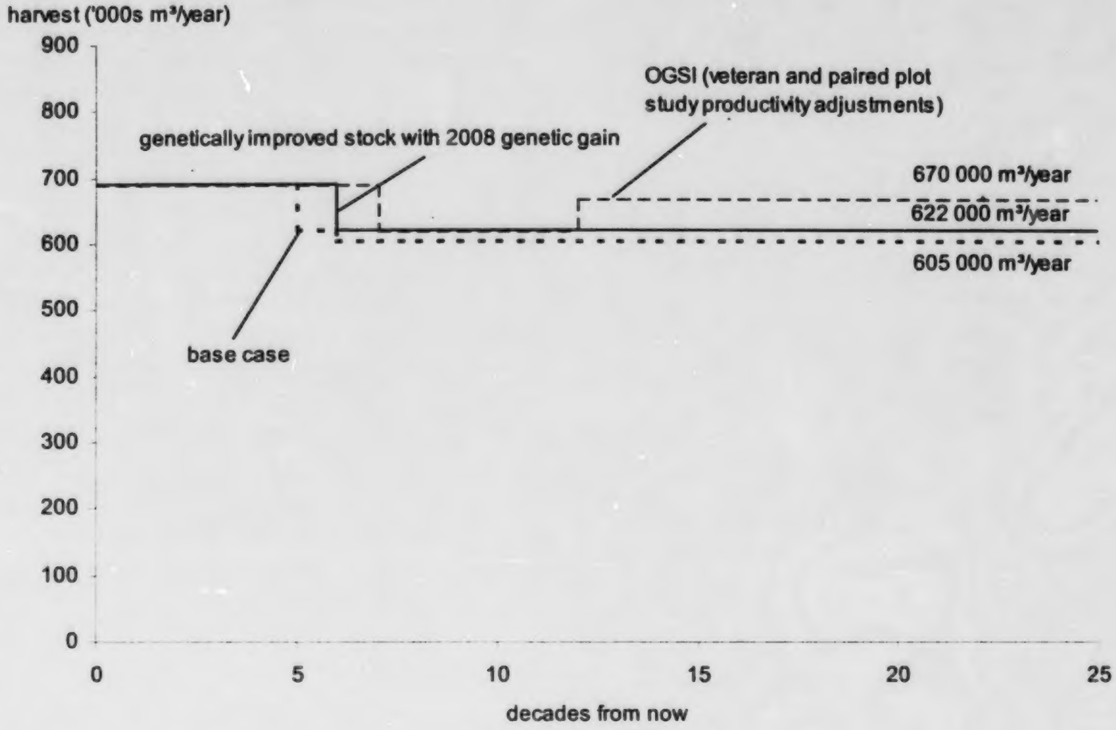


Figure 15. Harvest forecast if site productivity estimates of old stands were adjusted with paired plot and veteran OGSI studies and 2008 genetic gain levels assumed— Kootenay Lake TSA, 2001.

5.3 Uncertainty in volume reductions caused by root rot in regenerated stands

Armillaria ostoyae is a fungus that causes root disease and subsequent tree mortality in many tree species in southern British Columbia. It is very difficult to determine the extent and impact of this disease because it is not readily visible, and trees may not exhibit effects for a long period of time.

5 Timber Supply Sensitivity Analyses

To account for decay, waste, and breakage, as well as endemic diseases and pests which kill trees slowly over time, secondary operational adjustment factors (OAF 2) are applied to managed stand growth and yield estimates. *The effect of* OAF2 *is* to reduce the estimated volume gradually over time so that by age 100 years the volume is reduced by the OAF2 factor. Beyond 100 years, the OAF2 factor reduces the available volume* by an increasing amount per year. To reflect the expectation that losses from root rot in the Kootenay Lake TSA would exceed losses expressed in stands used to calibrate the provincial OAF2 estimate, the base case forecast OAF2 value was increased from 5% to 7% for all managed stands.

Figure 16 shows that if OAF2 was increased to 20% that the short-term harvest level can be maintained for the same duration as the base case, but the long-term harvest level would be more than 9% lower.

Root rot may also affect stand height growth. The site productivity estimates used in this analysis are based on inventory height estimates. If root rot is already widely distributed and is affecting thrifty or mature stands in the TSA, root rot may have impeded height growth and thus lowered the site productivity estimates used in this analysis. If root rot has not affected heights (and thus productivity estimates) of existing stands, but will affect managed stands, the time to obtain many of the forest cover objectives, which are generally based on the attainment of a particular height may be underestimated. Neither the base case, nor the sensitivity analysis, which both use OAF2 values to alter volume estimates, reflect the potential effects of root rot on height growth — unless as previously stated the impact is already incorporated in productivity estimates of the inventory. At this time there is little information available with which to quantify the extent and effect of root rot in regenerated stands.

Available volumes
The portion of total inventory volumes that is available for harvesting after all management constraints on timber harvesting have been considered, including definition of the timber harvesting land base, age of tree merchantability, deferrals, and any other priorities or constraints on timber harvesting.

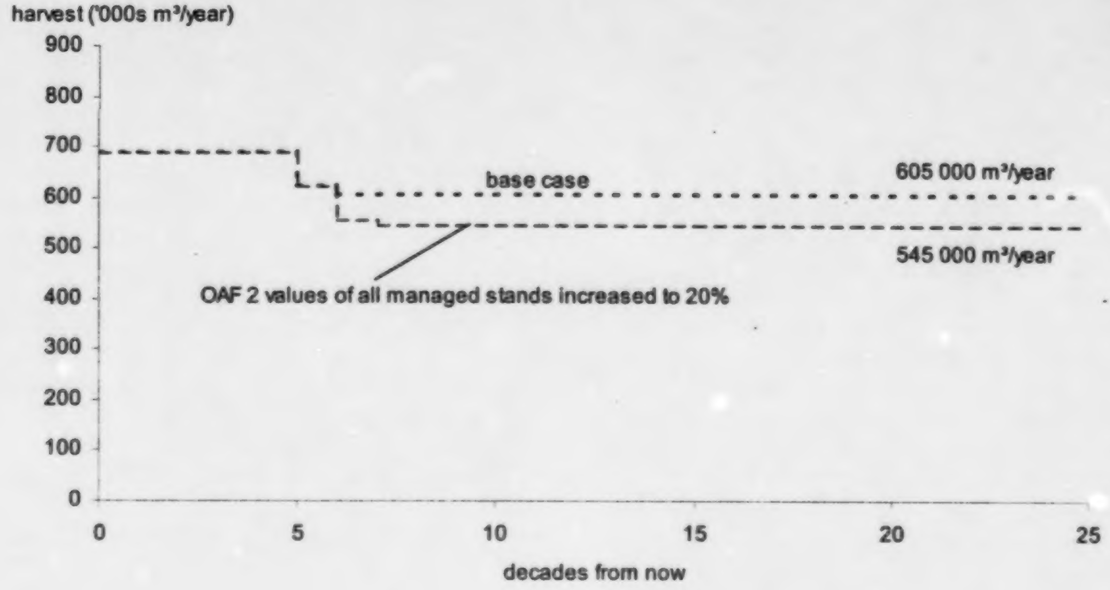


Figure 16. Harvest forecast if operational adjustment factor 2 (OAF2) is increased to 20%— Kootenay Lake TSA, 2001.

5.4 Uncertainty in biodiversity seral stage requirements

The *Forest Practices Code of British Columbia Act* describes the conservation of biological diversity as an essential component of sustainable use of forests. The *Landscape Unit Planning Guide* (LUPG) provides recommendations for maintaining biodiversity at both the stand and landscape levels. Stand-level biodiversity has been addressed in this analysis through volume reductions for each stand on the timber harvesting land base. Therefore, the potential effects of uncertainty about stand-level biodiversity can be assessed through the sensitivity analyses that examine uncertainty in timber yields. Landscape-level biodiversity, however, has been represented in this analysis by forest cover requirements applied to natural disturbance types within landscape units. There is uncertainty about how the recommendations in the *Landscape Unit Planning Guide* should be interpreted and applied. The following sensitivity analyses provided an indication of timber supply impacts associated with uncertainty about how the *Landscape Unit Planning Guide* seral distribution targets are applied in order to meet landscape-level biodiversity requirements.

5 Timber Supply Sensitivity Analyses

In some cases forested stands may not meet mature- or old-seral biodiversity objectives by the time they have achieved the seral stage* ages specified in the *Biodiversity Guidebook*. Similarly, some stands may achieve the characteristics of a mature- or old-seral stand before the age specified by the *Guidebook*. To investigate the timber supply sensitivity to uncertainty in seral stage age definitions, harvest forecasts were prepared with mature age definitions 20 years younger and 20 years older than specified by the *Guidebook*. Sensitivity analysis was also conducted with old-seral age requirements that were varied by plus and minus 40 years. Altering the mature seral* age definitions by 20 years, or increasing the old seral* age requirement by 40 years, did not result in any variance from the base case harvest forecast. However, reducing old-seral age requirements by 40 years permits extension of the initial harvest level for an additional decade.

In the base case, old seral objectives are phased in for areas of low biodiversity emphasis. The full objective is applied at 140 years in order to provide enough time to allow forest aging to achieve full attainment by the end of the third rotation (210 years). Immediate attainment of full old seral objectives in all areas (regardless of emphasis objectives) shortens the period of time that the initial harvest level could be sustained (by one decade relative to the base case).

The base case harvest forecast is not sensitive to landscape-level biodiversity early seral* age requirements. This relative insensitivity arises from the seral objectives being satisfied by areas outside of the timber harvesting land base, and contributions to seral objectives from other zones with non-timber values (e.g., scenic values) which constrain timber supply.

The results of sensitivity analyses of reducing old seral age by 40 years and immediate implementation for all old seral biodiversity are depicted in Figure 17.

Seral stages
Sequential stages in the development of plant communities that successively occupy a site and replace each other over time.
Mature seral
Forest stands with trees between 80 and 120 years old, depending on species, site conditions and biogeoclimatic zone.

Old seral
Old seral refers to forests with appropriate old forest characteristics. Ages vary depending on forest type and biogeoclimatic variant.
Early seral
Stands are defined as early seral if they are younger than 40 years of age. An exception is deciduous-dominated stands in the Boreal White and Black Spruce biogeoclimatic zone, which are defined as early seral up to 20 years of age.

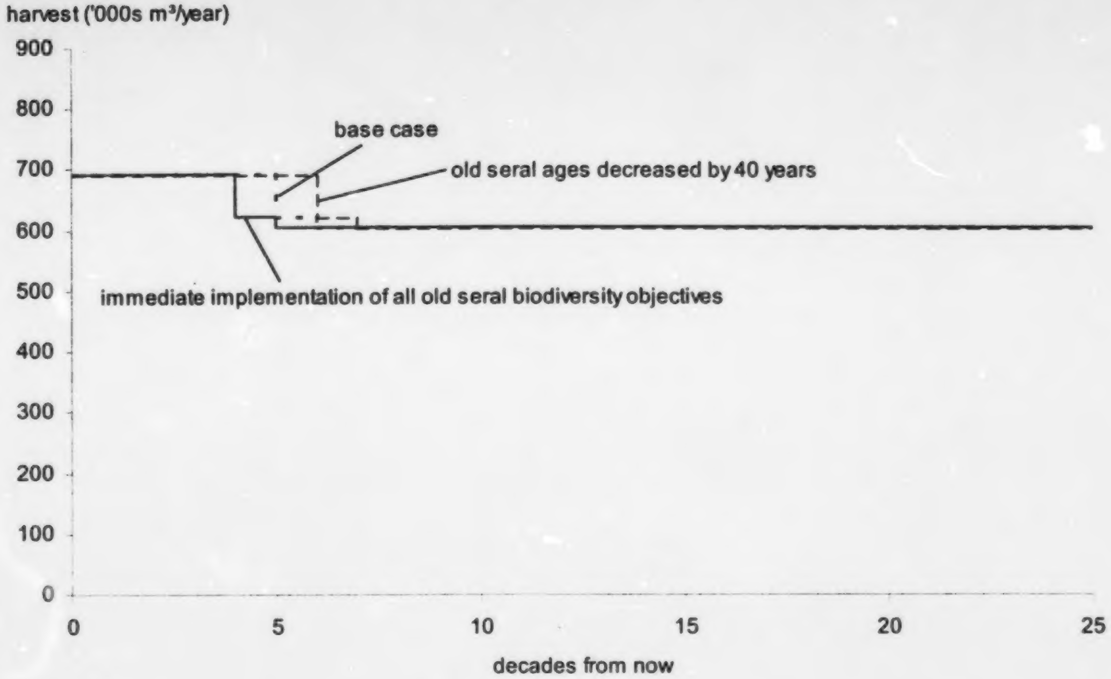


Figure 17. Potential harvest forecasts if old seral age requirements are decreased by 40 years or are required immediately— Kootenay Lake TSA, 2001.

Consistent with the recent direction in applying the *Landscape Unit Planning Guide*, the base case forecast forest cover requirements for seral stage biodiversity guidelines were assumed to be met, to the extent possible, first from forests outside the timber harvesting land base, and then from forest within the timber harvesting land base. A number of analyses have been conducted in the Nelson Forest Region to examine the implications of applying biodiversity requirements separately to the operable and inoperable portions of the crown productive forest land base. A more restrictive sensitivity analysis was conducted which required the productive forest within the timber harvesting land base meet the landscape-level biodiversity objectives without the contribution of productive forest excluded from timber supply. As shown in Figure 18 such a requirement would mean that the initial harvest level would have to decline 20 years earlier than the base case.

For the base case forecast it was assumed that forests excluded from the timber harvesting land base will continue to age over time so that, eventually they will all be over 250 years old. Since forests excluded from harvest will be subject to at least some natural disturbance, the ability of these forests to meet seral requirements for landscape-level biodiversity may be jeopardized. An alternative modelling approach would be to assume that the existing age class distribution in excluded stands remains the same over time (i.e., that disturbances will offset the aging of the forest). Figure 18 shows the impact of this static, or non-aging approach, to the base case harvest forecast. Assuming this approach, and given the significant area of juvenile forest outside of the timber harvesting land base (see Figure 5), the initial harvest level would have to be reduced immediately by 25 % to a sustainable long-term level of 514 000 cubic metres per year.

The static approach, however, assumes a level of natural disturbance that is unlikely, since fire suppression will most likely enable a higher proportion of excluded forest to age undisturbed over time than in the past. Therefore, if no aging is assumed, the future contribution to old-seral requirements made by currently young stands outside the timber harvesting land base would be underestimated.

5 Timber Supply Sensitivity Analyses

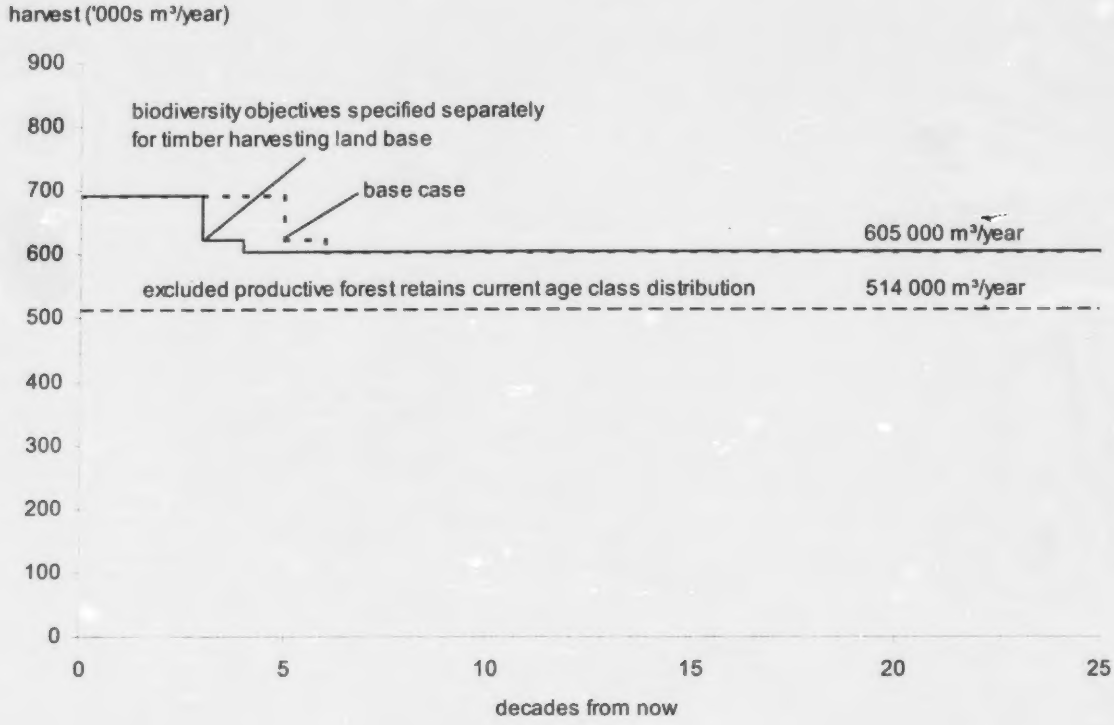


Figure 18. Harvest forecast implications of specifying biodiversity objectives separately for timber harvesting land base, and assuming excluded productive forest does not age — Kootenay Lake TSA, 2001.

In summary, an assumption that forest outside the harvesting land base will continue to age indefinitely probably over-estimates the contribution to old-seral requirements, while assuming that the overall age composition of the non-harvesting land base will remain static probably underestimates the future contribution of these forests to old-forest retention. Therefore, the base case forecast and the static forecast shown in Figure 18 show the likely bounds of the timber supply effects of uncertainty in the contribution of forest outside the timber harvesting land base.

5.5 Uncertainty in land base available for harvesting

Defining the timber harvesting land base for this analysis involved several assumptions about the types of forest land that are available for harvesting. Inventory classifications were used to identify areas to be excluded from timber harvesting. Since there is uncertainty in the inventory data, there is some uncertainty about how much area actually is in the timber harvesting land base under current management. One aspect of this uncertainty is associated with the accuracy of the operability mapping. While approximately 8% of the harvest from 1993-1998 came from areas outside of the area defined as operable, Kootenay Lake District staff have observed that other areas mapped as operable are actually infeasible to log. The recent harvest profile indicates a slight preference for less steep areas, and gives some weight to this argument.

5 Timber Supply Sensitivity Analyses

Currently it is not possible to assess whether the timber harvesting land base has been over- or underestimated, so two sensitivity analyses were performed. The first evaluates the impact of increasing the timber harvesting land base by 10% and reducing the non-timber harvesting land base by an equivalent area. The second evaluates the impact of shifting 10% of the timber harvesting land base to the non-timber harvesting land base.

The harvest forecasts of the sensitivity analysis show (in Figure 19) that if the timber harvesting land base is overestimated in the base case forecast, there is only enough volume in older existing stands to support the initial harvest level for three decades. After three decades, the harvest level then decreases in two stages by a total of 14%, to a long-term harvest level of 545 000 cubic metres per year (10% less than the base case). If the timber harvesting land base is larger than the base case the existing harvest level can be maintained until the end of tenth decade, before declining to a long-term level of 665 000 cubic metres per year. With an increase in timber harvesting land base it would also be possible to increase the initial harvest level above the level selected for the base case, however this could not be sustained for as long a period, and would require a larger decline to a long-term level.

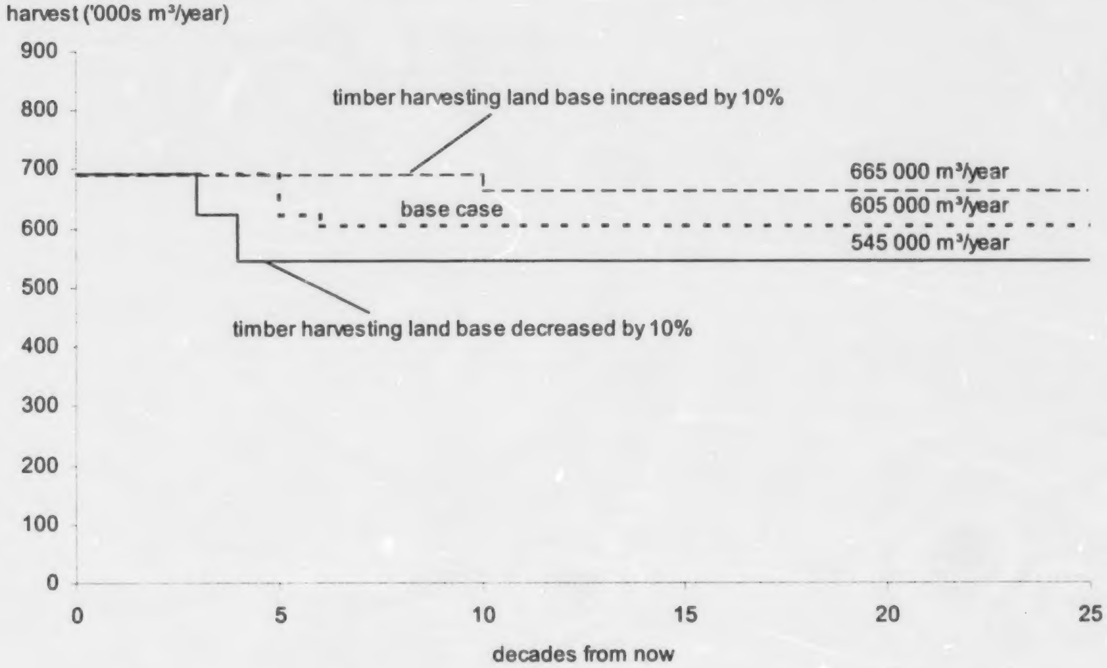


Figure 19. Harvest forecasts if timber harvesting land base is increased or decreased by 10% — Kootenay Lake TSA, 2001.

5.6 Uncertainty in the estimated existing stand yields

Timber volume estimates for existing unmanaged stands are subject to uncertainties in the forest inventory measurements (e.g., estimated tree heights and stand ages), and the statistical process used to develop the equations for predicting forest growth and yield. An inventory audit of the Kootenay Lake TSA found no statistically significant differences between volumes calculated using inventory information and volumes determined using field measurements. However, given the importance of existing mature stand volumes in defining timber supply over the short- and medium-terms, a standard sensitivity analysis was performed to assess the potential effect on timber supply of uncertainty in the estimates of existing stand volumes.

Figure 20 shows that if existing stand volumes are decreased by 10%, the current harvest level would have to immediately drop to 622 000 cubic metres per year which is 10% lower than the base case initial harvest level. After a further 3% decline in the second decade, the timber supply forecast would achieve a sustainable long-term level equivalent to the base case of 605 000 cubic metres per year.

An alternative forecast (not shown in the figure) which maintained the initial harvest level for one decade, with the reduced existing yields was also investigated. Maintaining the initial forecast for one decade followed by a decline to the base case long-term level over the following two decades results in a 5% shortfall in the eleventh decade.

Increasing existing stand volume estimates by 10% permits the extension of the initial harvest level by four decades and could permit a higher initial harvest level, although for a shorter period of time.

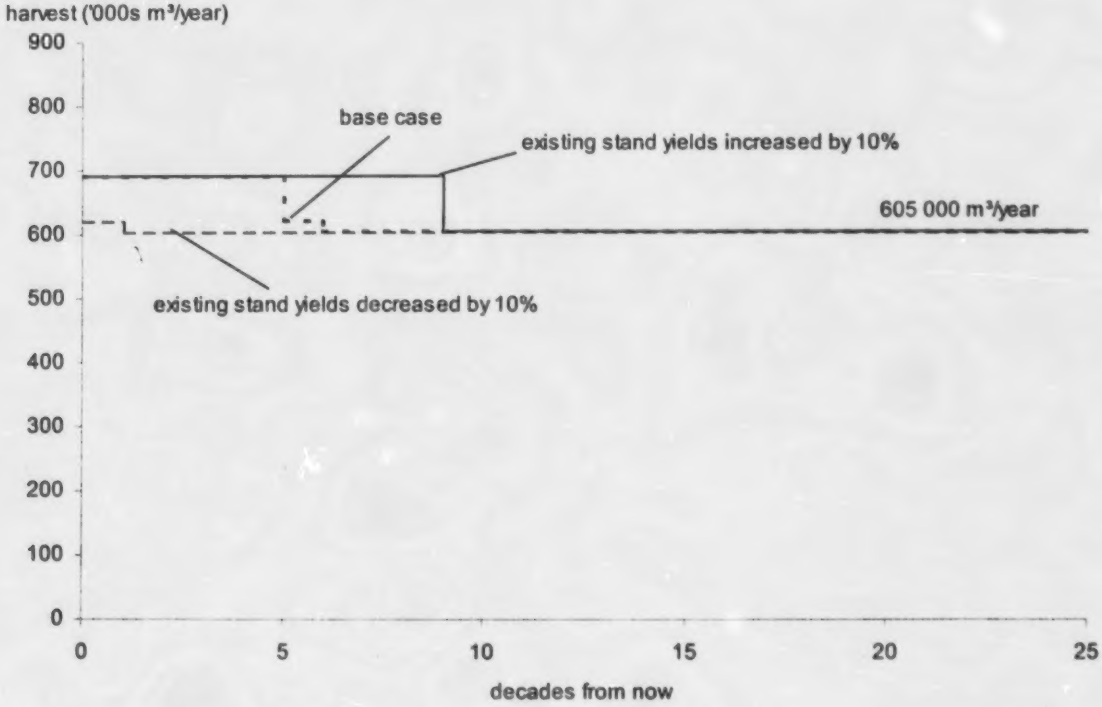


Figure 20. Harvest forecasts if existing (unmanaged) stand yields are over- or underestimated by 10%—Kootenay Lake TSA, 2001.

5.7 Uncertainty in estimated managed stand yields

Uncertainty in volume estimates for managed stands exists for the same reasons listed for existing stand yield estimates (inaccuracies in the forest inventory and the growth and yield models), but also because of the limited experience and data that is available for regenerated managed stands in B.C. There is also uncertainty associated with the site productivity assigned to older unmanaged stands relative to the site productivity expressed by the stands after they regenerate. This latter issue is examined in Section 5.2.

Apart from volume estimates, the choice of silvicultural regime will also affect the number of expected stems, piece size and quality of the timber harvested from managed stands.

Figure 21 shows the results of uncertainty in managed stand yields. If volume estimates for regenerated stands are 10% higher than assumed for the base case, the long-term harvest level would be 10% higher. Conversely, if volume estimates for regenerated stands are 10% lower, the long-term harvest level would be 10% lower than in the base case. The timing of the transition to the long-term level is also affected by the amount of merchantable managed volume. Higher managed stand yields mean the initial harvest level can be sustained for an additional decade, without causing disruptions in mid-term timber supply.

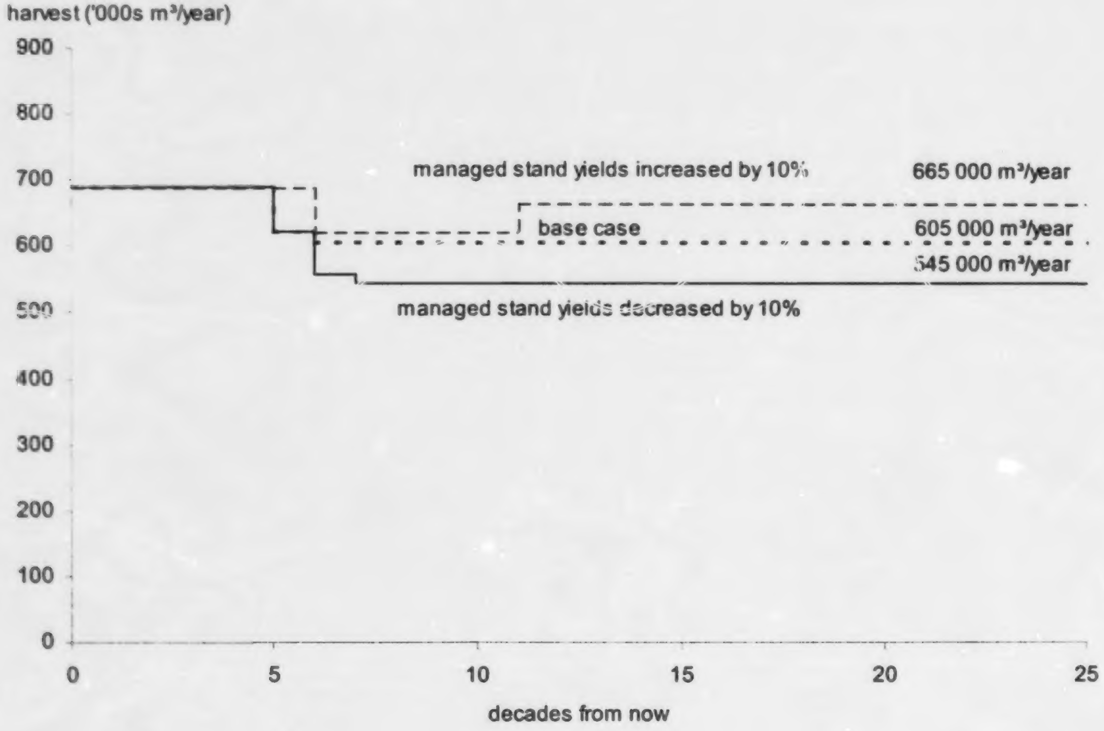


Figure 21. Harvest forecasts if managed stand yields are over- or underestimated by 10%. — Kootenay Lake TSA, 2001.

5.8 Uncertainty in minimum harvestable ages

Minimum harvestable age is an estimate of the time needed for a stand to reach a merchantable condition. The time at which stands will become merchantable is highly uncertain. While this is partly due to uncertainty in forecasting growth rates of regenerated stands, it is largely because we cannot foresee future market and technological conditions that will determine merchantability.

For this analysis, minimum harvestable ages apply to both managed and unmanaged stands and were specified as the age at which a stand achieves 95% of maximum culmination mean annual increment (CMAI). For a detailed explanation please see Appendix A, "Description of Data Inputs and Assumptions for the Timber Supply Analysis." The harvestable ages are minimums; stands may be harvested at older ages but not younger ages. In the analysis, many stands are harvested at ages beyond the minimums because they are retained to meet objectives such as forest cover requirements.

Figure 22 shows how timber supply would change if the minimum harvestable ages specified in the base case were increased or decreased by 10%. The effect of changing minimum harvestable ages on harvest flows is limited to the long-term because most of the existing stands, which support the short- and mid-term, are already beyond minimum harvestable ages. Increasing minimum harvestable ages increases long-term timber supply (10% above base case) because it delays harvesting to ages when the stand is closer to maximum biological productivity (CMAI). Reducing the minimum harvestable ages, permits harvesting at ages well below maximum biological productivity and results in a long-term harvesting level 10% below the base case.

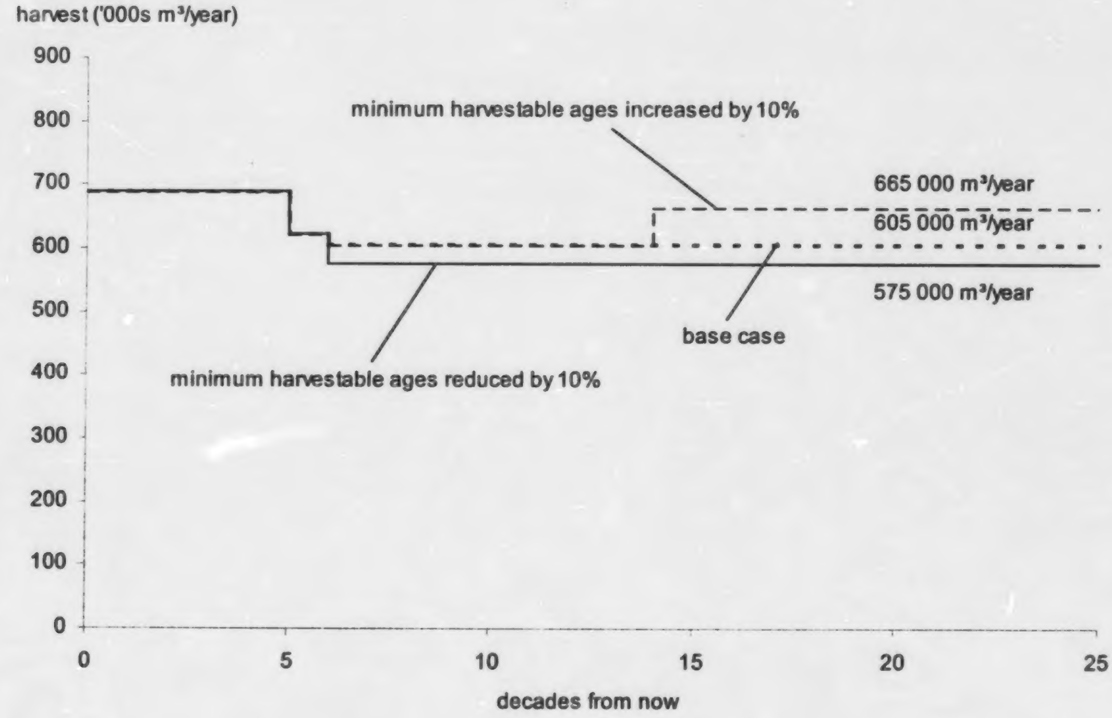


Figure 22. Harvest forecasts if minimum harvestable ages are increased or decreased by 10% — Kootenay Lake TSA, 2001.

5.9 Uncertainty in adjacency restrictions

As a proxy for the green-up requirements for adjacent stands specified by the *Forest Practices Code* and the *Kootenay-Boundary Implementation Strategy* the base case harvest forecast specified that a maximum of 33% of the timber harvesting land base could be below green-up age. This was applied at the landscape unit level to all areas not assigned more restrictive visual quality objectives. In the base case simulation this objective did not significantly limit timber supply. To determine the level at which this objective affected timber supply the maximum disturbance percentage was reduced until the base case forecast could not be sustained. As shown in Figure 23, the adjacency objective became limiting when the maximum disturbance was lowered to 18%, which produced a small (3%) shortfall in the eighth decade. Any further increase in adjacency constraints results in much more substantial impacts on timber supply.

For the base case, age of green-up was calculated for specified green-up height requirements using Site Tools and inventory estimates of site index. A sensitivity analysis which decreased and increased green-up age requirements (both visual and non-visual quality objectives) by five years demonstrates (see Figure 24) that timber supply is sensitive to changes in green-up ages in the mid-term.

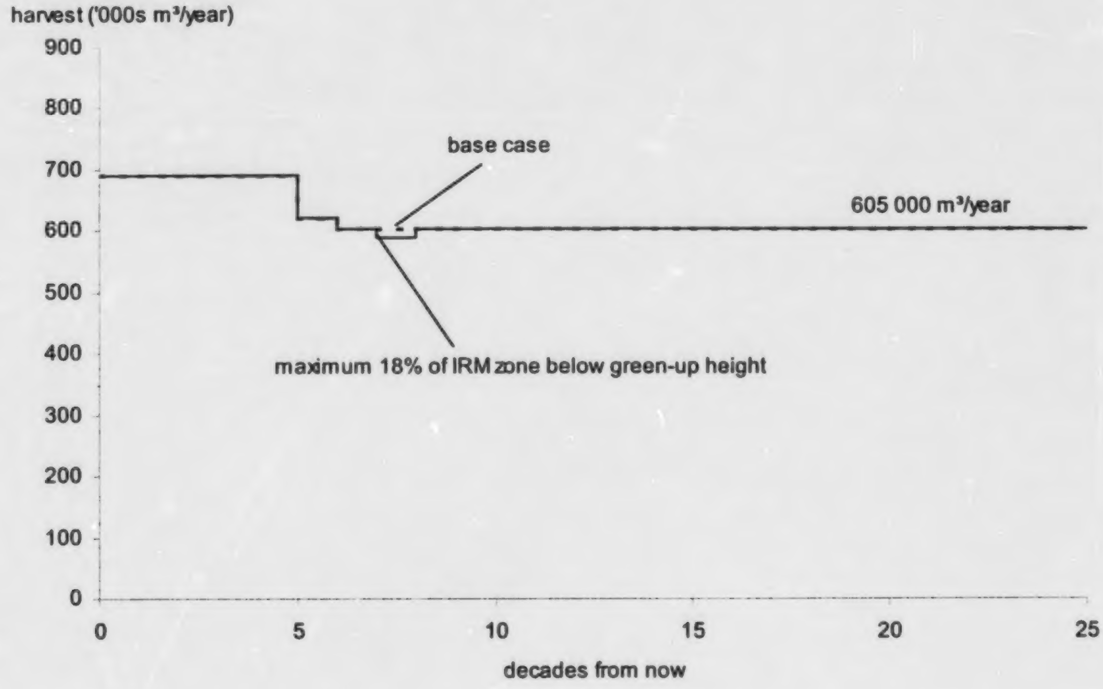


Figure 23. Harvest forecasts if IRM zone maximum disturbance limits reduced to 18%— Kootenay Lake TSA, 2001.

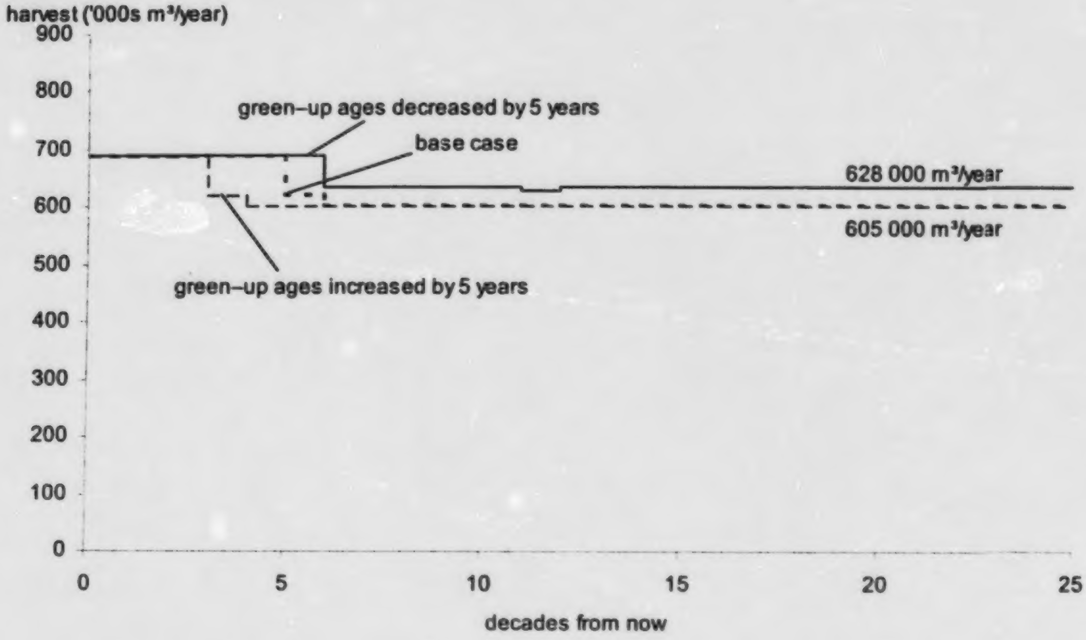


Figure 24. Harvest forecasts if green-up ages are increased or decreased by five years — Kootenay Lake TSA, 2001.

5.10 Alternative harvest queuing modelling approaches

While one of the Ministry of Forests' resource management objectives includes harvesting older stands before younger stands, review of Forest Development Plans and harvesting history indicate harvesting is occurring over a range of ages. It is believed that the logistics associated with non-timber objectives, existing access and harvesting patterns, and limited available growing stock reduce the latitude to focus harvesting on older stands first. To more closely approximate a harvesting pattern over a range of ages a random harvest queuing rule was chosen for the base case. A number of harvesting simulations were conducted to confirm that there was adequate stability in the harvest forecasts and statistics (e.g., average harvest age, total merchantable growing stock) to permit the use of a single random queue for all subsequent sensitivity analyses.

To investigate the sensitivity of the harvest forecast to changes in the harvest queuing rule, two sensitivity analyses were conducted with alternate rules. The first sensitivity gave priority to older stands. The second sensitivity analysis, gave priority to stands that were older relative to their minimum harvestable age.

As evident in Figure 25 these sensitivity analyses demonstrate that the initial harvest level can be maintained for a longer period of time and the long-term harvest level can be maintained at a higher level than the base case. This outcome is expected because scheduling of harvest by age means that stands will be harvested at ages which are closer to their maximum biological productive potential.

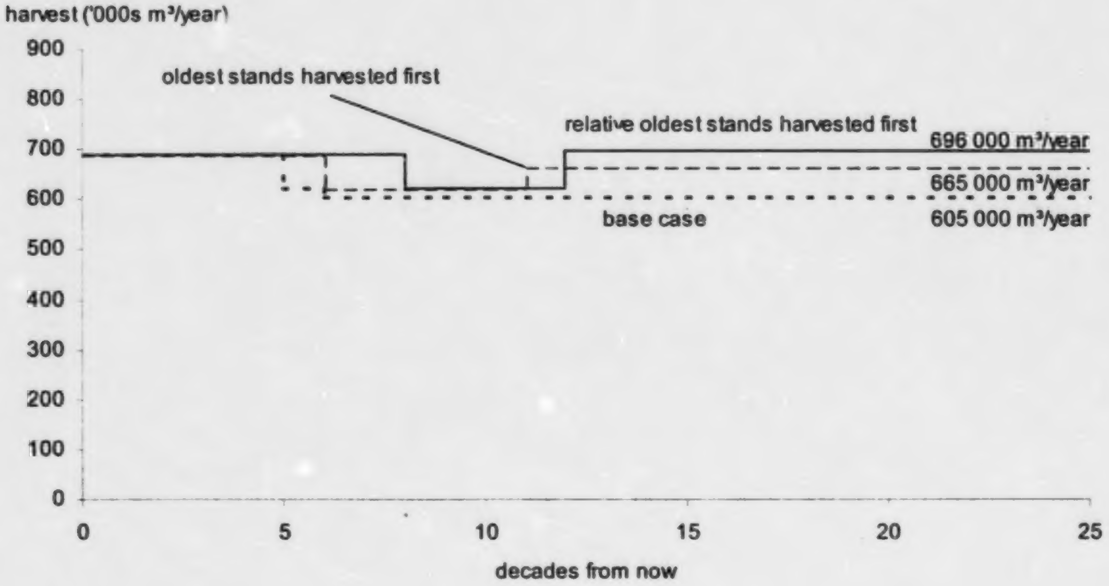


Figure 25. Alternative harvest scheduling rules: oldest first, relative oldest first and random — Kootenay Lake TSA, 2001.

5.11 Uncertainty associated with visual quality management objectives

About 35% of the Kootenay Lake TSA timber harvesting land base is subject to visual quality objectives. Most of this area (22% of the timber harvesting land base) is classified as partial retention visual quality class (VQC). Areas classified as retention VQC and modification VQC account for 4% and 9% of the timber harvesting land base, respectively. As shown in Figure 26 the initial harvest level could be sustained for two decades longer and the long-term harvest level increased by 5% relative to the base case, if all visual quality class disturbance limits were relaxed by five percentage points.

The disturbance levels specified for each visual quality class in the base case are the maximum permissible, assuming good visual design principles. As shown in Figure 26 reducing the permissible disturbance limits to the lower limit for each visual quality class zone reduced timber supply in the short-, medium- and long-term.

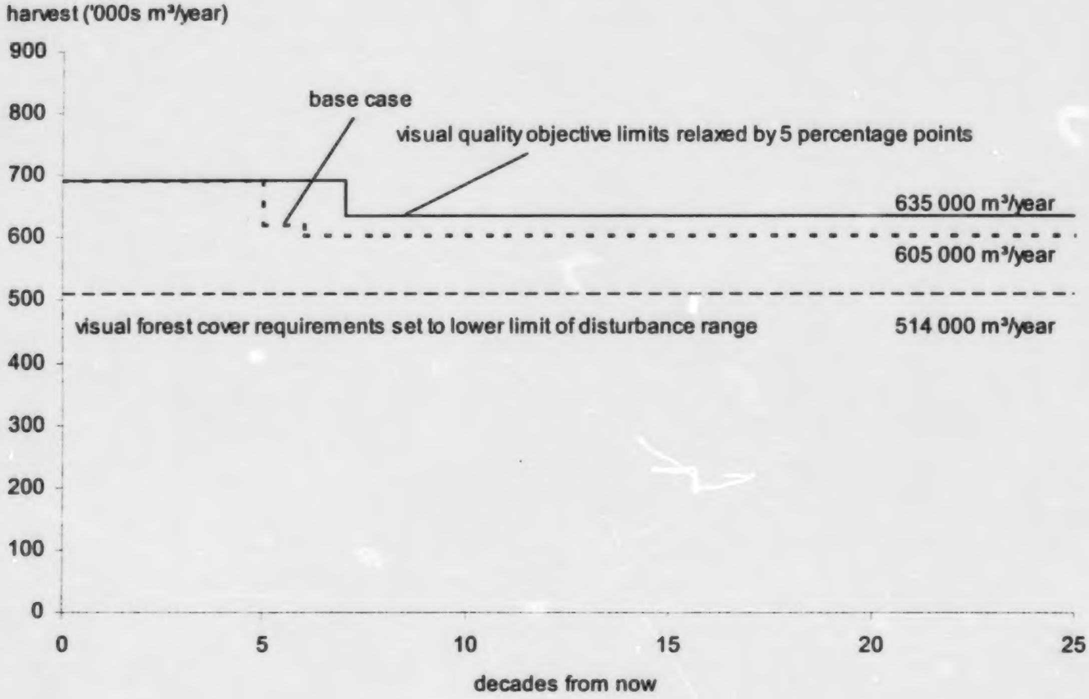


Figure 26. Harvest forecast if permissible disturbance is reduced to the lower limit for each visual quality class — Kootenay Lake TSA, 2001.

5.12 Uncertainty associated with modelling watershed management objectives

Community and domestic watersheds combined cover 317 310 hectares, or 29%, of the gross Crown land base of Kootenay Lake TSA, and 36% of the timber harvesting land base. The *Forest Practices Code Act of B.C.* regulates logging within these areas. Where water quality may be adversely impacted an assessment of the watershed hydrologic condition and existing and proposed development activities is conducted. Many factors, including the area of disturbance relative to the size of the watershed, the amount of road development, the logging methods employed, and the hydrologic structure of the watershed determine the extent of logging permitted. To simulate the restrictions placed on harvesting within watersheds, cover objectives, which limit the area that may be in a disturbed condition (i.e., not greened-up), were imposed. Because these simulations are a simplification of the restrictions placed on logging, a sensitivity analysis was conducted to assess the influence that changes in these assumptions might have on timber supply.

Reducing the permissible disturbance within both domestic and community watersheds by five percentage points, or by 10 percentage points just in community watersheds, reduced the period over which the initial harvest level could be sustained by one decade. Increasing the time to hydrological green-up age by 20% in community watersheds, or decreasing the permissible disturbance by five percentage points in community watersheds, did not result in any disruptions in the base case harvest forecast.

Table 4. Area of community and domestic watersheds — Kootenay Lake TSA, 2001

Watershed type	Gross crown area (hectares)	Productive forest area (hectares)	Timber harvesting land base area (hectares)	Portion of watershed type in timber harvesting land base	Portion of TSA timber harvesting land base in watershed type
Community	75 858	57 969	22 951	30%	9%
Class 1 domestic	29 895	25 354	16 657	56%	6%
Class 2 domestic	12 467	10 846	5 829	47%	2%
Class 3 domestic	199 090	119 286	47 874	24%	19%
All	317 310	213 455	93 311	29%	36%

5.13 Uncertainty associated with wildlife habitat modelling objectives

Management of timber resources for the maintenance of habitat for caribou and other ungulates was simulated by the application of forest cover objectives to areas defined by the *Kootenay-Boundary Land Use Plan Implementation Strategy*. Sensitivity analyses, which varied the cover objectives specified, were conducted to demonstrate the sensitivity of the timber supply to changes in these objectives.

While the caribou and ungulate winter range habitat zones both cover approximately the same amount of timber harvesting land base area (approximately 22% each) sensitivity analysis suggests that the caribou objectives influence timber supply more than ungulate winter range objectives. As shown in Figure 27, the period over which the initial harvest level can be sustained can be extended to six decades by reducing the caribou habitat old and mature cover objectives by five percentage points. However, reducing the ungulate winter range old-forest requirement by five percentage points would not support the extension of the initial harvest level. Increasing the caribou habitat objectives or the ungulate winter range objectives by five percentage points results in a one decade reduction in the period over which the initial harvest level can be sustained. Increasing both the caribou habitat and ungulate winter range old forest objectives by five percentage points reduced the period over which the base case initial harvest level could be sustained by two decades to 30 years (Figure 28). None of the wildlife habitat sensitivities influenced the long-term harvesting level attainable in the base case harvest forecast.

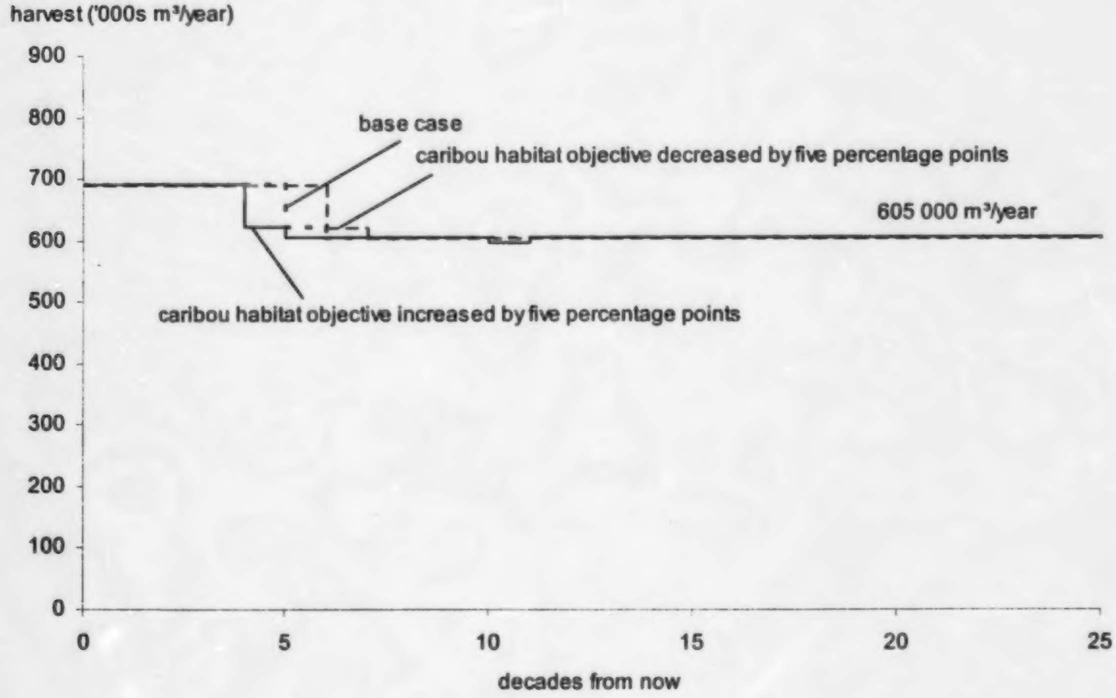


Figure 27. Harvest forecasts if caribou habitat old forest requirements are increased or decreased by five percentage points — Kootenay Lake TSA, 2001.

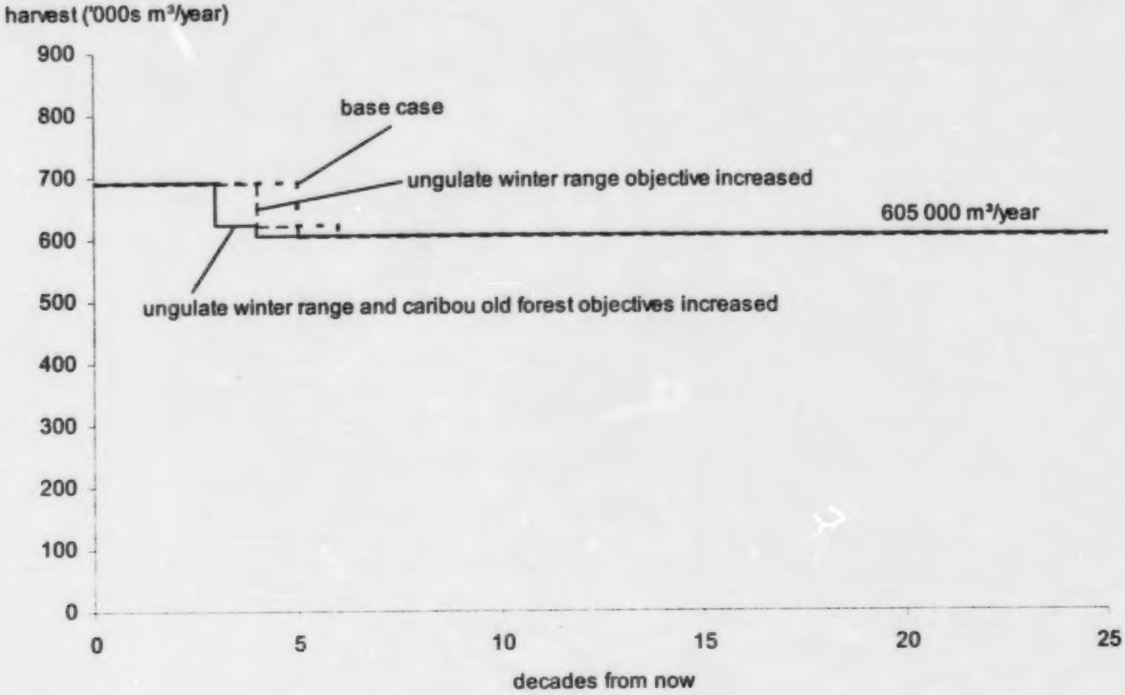


Figure 28. Harvest forecasts if ungulate winter range, or ungulate winter range and caribou old forest requirements are increased by five percentage points — Kootenay Lake TSA, 2001.

6 Summary and Conclusion of the Timber Supply Analysis

The base case uses current inventory and timber growth information and assumes continuation of current forest management practices, including most aspects of the *Kootenay-Boundary Higher Level Plan*.

The analysis determined that almost 50% of the TSA is productive forest under crown management and 21% is available for timber harvesting. Thirty-six per cent of the timber harvesting land base is managed as watershed, 35% for aesthetics, 23% for caribou habitat, and 22% for ungulate winter range. In all cases where these alternate values are identified harvesting is managed within limits specified to protect these values which are considered to have priority over timber.

The results of the base case harvest forecast suggest that the initial harvest level of 691 000 cubic metres per year, which is equivalent to the current AAC (exclusive of the newly issued or expanded woodlots), can be maintained for up to 50 years without requiring substantial and rapid future harvest level reductions or creating severe future timber disruptions.

The base case modelled in this analysis maintains the initial harvest level for a longer period than was possible in the 1993 analysis (TSR 1), but at a level which is 14% below the TSR 1 initial harvest level. The base case long-term harvest level in this analysis is 23% higher than the TSR 1 base case.

The base case results reflect current knowledge and information on forest inventory, growth and management. However, uncertainty exists about several factors important in defining timber supply. A series of sensitivity analyses showed that these uncertainties affect timber supply in varying degrees at different points in time.

As confirmed by sensitivity analysis, more restrictive visual quality objectives, and/or reduced existing stand yields could reduce short-term timber supply. A recent inventory audit did not indicate statistically significant problems with existing volume estimates. Sensitivity analysis also showed the short-term harvest level could be jeopardized if the current age class distribution of productive forest areas outside of the timber harvesting land base is maintained by disturbance. Whether this age class distribution, which reflects a significant fire history will endure given the current fire protection management regime is debatable.

The period of time that the initial harvest level can be sustained could be shortened by: (1) reducing the timber harvesting land base, (2) increasing green-up ages, (3) specifying biodiversity constraints separately on the timber harvesting land base and the productive forest, (4) increasing the caribou or ungulate winter range habitat objectives, (5) reducing the disturbance allowable in community and domestic watersheds, and/or (6) specifying full old seral biodiversity objectives immediately.

The period of time that the initial harvest level can be sustained may be extended by: (1) increasing existing or managed stand yield estimates, (2) applying old growth site index equations, (3) applying genetic worth estimates, (4) reducing green-up ages, (5) reducing caribou habitat cover objectives, (6) increasing the area of timber harvesting land base, (7) specifying that oldest or relative oldest stands are harvested first, (8) reducing visual quality objectives, and/or (9) reducing the landscape-level biodiversity old seral age requirement.

The following changes in modelled assumptions, were confirmed by sensitivity analysis to reduce long-term harvest levels: (1) decreasing the timber harvesting land base area, (2) decreasing managed stand yields, (3) reducing minimum harvestable ages, (4) increasing expected mature losses (OAF 2) in managed stand yields, (5) assuming the current age class distribution of the area excluded from timber harvesting will remain constant, and/or (6) reducing visual quality class objectives to minimum disturbance values for each class.

Sensitivity analysis confirmed the following changes in modelling parameters could support higher long-term harvest levels: (1) increasing the timber harvesting land base area, (2) increasing managed stand yields, (3) incorporating genetic gain from tree breeding, (4) incorporating higher site indexes for land occupied by older stands, (5) increasing minimum harvestable ages, and/or (6) adopting oldest first, or relative oldest first harvest queuing rules.

6 Summary and Conclusion of the Timber Supply Analysis

The base case adopts the most certain, best known information available. While many uncertainties have the potential to change the base case harvest forecast, there are relatively few where this seems likely to occur. The two factors with the greatest likelihood of occurring: the adoption of site index adjustment procedures for old growth and adjustment of growth information to reflect genetic gain from planting improved stock, have positive effects on timber supply. There is a significant level of uncertainty about operability, the effects of *Armillaria* root disease, and the future age class distribution of the excluded productive forest. Further studies may provide better insight into these uncertainties, however, at the present the base case reflects the best estimates of these parameters.

In conclusion, the base case analysis indicates that based on current inventory and growth and yield information, and the current management regime, timber harvests in the Kootenay Lake TSA could be maintained at the current allowable level for the next 50 years. The analysis indicates that several factors related to the current forest inventory and management regime could affect long-term timber supply, but relatively few uncertainties influence short-term timber supply.

7 Socio-Economic Analysis

The impact of timber supply adjustments on local communities and the provincial economy is an important consideration in the Timber Supply Review. This analysis examines the socio-economic implications of alternative harvest levels in the Kootenay Lake TSA. It compares the level of forestry activity currently supported by timber harvested from the Kootenay Lake TSA to the level of activity that could be supported as the timber supply in the Kootenay Lake TSA moves towards the long-term harvest level. The analysis uses the base case harvest forecast as an indication of future timber supply levels.

The socio-economic analysis includes:

- a profile of the current socio-economic setting;
- a description of the forest industry; and
- an analysis of the socio-economic implications of the base case harvest forecast.

7.1 Current socio-economic setting

7.1.1 Population and demographic trends

The Kootenay Lake TSA, one of seven TSAs in the Nelson Forest Region, has a population of approximately 33,000 people (1996 Census). The major communities of Nelson, Creston and Kaslo have a combined population of more than 16,000. Smaller communities include Yahk, Wynndel, Lardeau and Meadow Creek. From 1991 to 1996, the population of the TSA increased 13%. The population of the TSA is projected to increase about 4.5% from 1996 to more than 34,000 (see Table 5).

Table 5. Population statistics, Kootenay Lake TSA

Communities	Population 1991 census	Population 1996 census	Estimated population 2001[a]	Per cent change 1996–2001 (%)
Creston	4,207	4,816	4,998	3.8
Kaslo	863	1,063	1,157	8.8
Meadow Creek/Lardeau	1,066	1,296	1,419	9.5
Nelson	8,849	9,585	10,094	5.3
Wynndel	1,063	1,021	1,154	13.0
Other communities	13,148	15,134	15,586	3.0
Kootenay Lake TSA	29,196	32,915	34,408	4.5

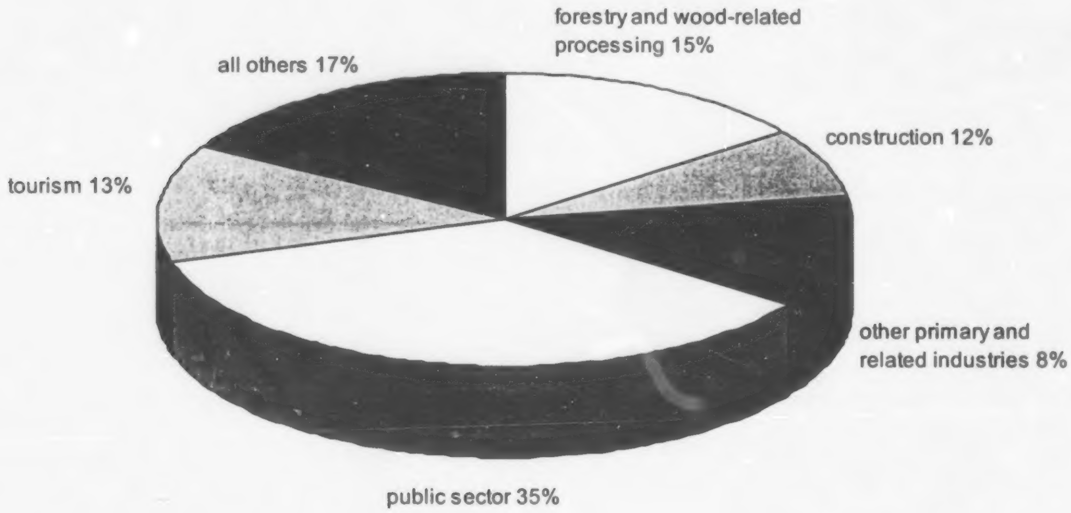
Sources: 1991 and 1996 Census data. Between the 1991 and 1996 Census, boundaries were changed for some enumeration areas. Population figures for some communities between the census may not be based on the same geographic area.

(a) Estimates are based on Local Health Area Population Projections. Data are from Population Section, BCSTATS.

7.1.2 Economic profile

From 1991 to 1996, the experienced labour force in the Kootenay Lake TSA increased by 18% to 16,000. In comparison, the experienced labour force for the province increased by 12% over the same period. The unemployment rate in the Kootenay Lake TSA was 9.8% in 1996, compared with 12.4% in 1991. As Figure 27 illustrates, the major employment sectors in the Kootenay Lake TSA are the public sector (which includes education, health, and federal, provincial and local public services), forestry and tourism. Figures from the 1996 Census indicate that the forestry sector accounted for about 15% of employment (direct, indirect and induced) in the TSA.

Tourism, which includes portions of several service sectors including accommodation services, retail trade and transportation, has demonstrated significant growth and investment in recent years. Almost 2,000 persons are employed in the Kootenay Lake TSA's tourism sector, catering to both tourist and business travellers. Nearly 300 businesses in the Kootenay Lake TSA service visitors' needs, including outdoor recreation facilities, tours and attractions, retail and service businesses, food and beverage facilities, and accommodations.



Source: 1996 Census.

Figure 29. Estimates of employment by sector, Kootenay Lake TSA, 1996.

7 Socio-Economic Analysis

Income, whether business or personal, is another indicator of a sector's contribution to the economy. Jobs in sectors with high income levels tend to support more employment per job than those in sectors with lower income levels. Statistics Canada labour force data, comparing average weekly earnings in different sectors of the economy, indicate that the forestry sector is one of the highest paying sectors and, therefore, a major contributor to the local and provincial economies. Mining is the only sector that has consistently paid higher wages than forestry. In 1999, the average weekly earnings (before income taxes) in the forestry sector were about $962, compared with $1,165 for the mining sector. Other sectors' average weekly earnings were $697 for the construction industry; $244 for the accommodation, food and beverage services industries; and $797 for the public sector.

Employment multipliers* reflect the income effect: the greater the multiplier, the greater the impact that each job in this sector has on the economy. For example, estimates by the Ministry of Finance and Corporate Relations indicate that for every 100 full-time direct forestry jobs in the Kootenay Lake TSA, another 34–109 indirect and induced jobs* are supported, depending on the forestry activity (harvesting or timber processing). In comparison, for every 100 full-time direct jobs in the tourism sector, an estimated additional 7–20 indirect and induced jobs are supported. The differences are due to greater spending patterns by both forestry sector businesses and their employees. Table 6 compares estimated employment, average weekly earnings and employment multipliers for selected industry sectors of the Kootenay Lake TSA.

Table 6. Average weekly earnings and employment multipliers, Kootenay Lake TSA

Industry sector	1999 average weekly earnings ($)	Employment multiplier[a]
Forestry and related	962	1.34–2.09
Mining and related	1,165	1.49–1.67
Construction	697	1.35–1.51
Tourism[b]	244	1.07–1.20
Public sector	797	1.17–1.35

Sources: Statistics Canada. 1999. Estimates of average weekly earnings. (Weekly earnings are before income taxes).

Ministry of Finance and Corporate Relations. 1999. The 1996 forest district tables. Refers to 1996 Census data..

(a) Includes direct, indirect and induced jobs.

(b) In B.C., the average weekly earnings for those in the tourism sector ranges from $220 for food service workers to $362 for hotel workers. In 1999, there were more than four times the number of workers in food services than in hotels, motels and trailer courts services in the province. The average weekly earnings in the tourism sector reflect, therefore, the larger portion of workers who have the lower average weekly earnings.

Employment multiplier
An estimate of the total employment supported by each direct job, for example a multiplier of 2.0 means that one direct job supports one additional indirect and induced job.

Indirect and induced jobs
Indirect jobs are supported by direct business purchases of goods and services. Induced jobs are supported by employee purchases of goods and services; for example, at retail outlets.

7 Socio-Economic Analysis

7.2 Description of the forest industry

7.2.1 Current allowable annual cut

The current allowable annual cut (AAC) for the Kootenay Lake TSA is 700 000 cubic metres. This level was set by the chief forester in March 1995, and was a 22% reduction from the previous level of 900 000 cubic metres. Forest licences account for more than 75% of the apportioned volume in the TSA, and the Ministry of Forests' Small Business Forest Enterprise Program (SBFEP) accounts for about 20% of the apportioned volume. Table 7 indicates the current apportioned AAC by type of licence.

Table 7. Allowable annual cut apportionment, Kootenay Lake TSA

Type of licence	Volume (m^3)	Per cent (%)
Forest licences, replaceable	506 403	72.3
Forest licences, non-replaceable	25 000	3.6
Timber sale licence (TSL) < 10 000 m^3, replaceable	285	> 1.0
Small Business Forest Enterprise Program (SBFEP)	143 010	20.4
Forest Service Reserve	7 002	1.0
Woodlot licences	18 300	2.6
Total	700 000	100.0

Source: Ministry of Forests, Resource Tenures and Engineering Branch.

7.2.2 Recent harvest history

The actual annual harvest level is an important indicator of forestry activity in the TSA. Subject to cut control flexibility, the AAC is the maximum allowable annual harvest level, but the actual volume of timber harvested in a particular year determines the level of economic activity.[1] If actual annual harvest levels are less than the AAC, then the economic activity is less than the TSA's full potential. A persistent gap between the AAC and the actual annual harvest level could influence the potential short-term impacts of changes in the AAC. Table 8 summarizes the volume of timber harvested in the Kootenay Lake TSA from 1995 to 1999.

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(1) Cut control permits licensees to vary the volume between annual harvest and AAC by ± 50% per year and by ± 10% over a five-year period. This variability gives licensees the flexibility to adapt to changing conditions, including changing markets.

Table 8. AAC and volume billed, by licence type, Kootenay Lake TSA, 1995–1999

	Cubic metres (m^3)					
Type of licence[a]	**1995**	**1996**	**1997**	**1998**	**1999**	**Average 1995-1999**
Forest licence	471 240	529 233	440 663	415 520	481 605	467 652
Small Business Forest Enterprise Program (SBFEP)	100 124	100 026	104 739	86 621	84 808	95 264
Other[b]	51 028	61 475	61 815	62 446	56 850	58 723
Total	622 392	690 734	607 217	564 587	623 263	621 639
Allowable annual cut	900 000	700 000	700 000	700 000	700 000	

Source: Ministry of Forests, Harvest Database.

(a) Timber harvested from private lands and woodlots is not included in the analysis of this report. Average annual harvest from private lands for the same period was 14 395 cubic metres and from woodlots was 12 289 cubic metres.

(b) Other includes cutting permits, timber sale licences, right-of-way clearings, roads, beach comb, trespass and other miscellaneous harvests not included elsewhere.

7.2.3 Major licensees and processing facilities

Atco Lumber Ltd.

Atco Lumber Ltd. (Atco) has a replaceable forest licence to harvest 20 167 cubic metres per year. All of the harvest from this licence is processed outside the TSA at the company's lumber/veneer mill in Fruitvale. Based on recent data, Atco's average annual harvest from this licence supported an estimated 17-23 person-years* of employment in harvesting, silviculture, timber processing and related activities (Table 9). About 15% of the workers associated with the harvesting and processing of the timber from this licence reside in the Kootenay Lake TSA.

Person-year(s)
One person working the equivalent of one full year, defined as at least 180 days of work. Someone working full-time for 90 days accounts for 0.5 person-years.

Table 9. Atco's harvest and direct employment statistics

Allowable annual cut	20 167 cubic metres
Annual average harvest — forest licence (1997-1999)	18 606 cubic metres
1999 harvest	17 637 cubic metres
Estimated employment (person-years)[a]	
Harvesting and administration	6-7
Log transport	1-2
Road construction and maintenance	> 1
Silviculture	1-2
Timber processing	8-11
Total	17-23

Source: Ministry of Forests, Harvest Database.

(a) Estimates of employment are based on 1997–1999 average annual harvest of 18 606 cubic metres. Estimates are derived from information supplied by the licensee and include employment associated with TSA timber that is processed outside the TSA.

Celcrest TimberLimited and Wynndel Box & Lumber Company Ltd.

Celcrest Timber Limited and Wynndel Box & Lumber Company Ltd. (Celcrest) has a replaceable forest licence to harvest 65 461 cubic metres per year. All the timber harvested from this licence is processed in the company's lumber mill in Wynndel, located within the Kootenay Lake TSA.

Based on recent data, Celcrest's average annual harvest from this licence supported an estimated 110-115 person-years of employment in harvesting, silviculture, timber processing and related activities (Table 10). Almost all the workers associated with the harvesting and processing of the timber from this licence live in the Kootenay Lake TSA.

Table 10. Celcrest's harvest and direct employment statistics

Allowable annual cut	65 461 cubic metres
Annual average harvest (1997-1999)	63 534 cubic metres
1999 harvest	65 915 cubic metres
Estimated employment (person-years)[a]	
Harvesting and administration	33-37
Log transport	4-8
Road construction and maintenance	8-9
Silviculture	2-3
Timber processing	53-58
Total	100-115

Source: Ministry of Forests, Harvest Database.

(a) Estimates of employment are based on 1997-1999 average annual harvest of 63 534 cubic metres. Estimates are derived from information supplied by the licensee and include employment associated with TSA timber that is processed outside the TSA.

7 Socio-Economic Analysis

Tembec Industries Inc,
(formerly Crestbrook Forest Industries Ltd.)

Tembec Industries Inc. (Tembec) has a replaceable forest licence to harvest 115 216 cubic metres per year. All the harvested timber from this licence is processed in the company's lumber mills outside the Kootenay Lake TSA. Based on recent data, Tembec's average annual harvest from this licence supported an estimated 116-135 person-years of employment in harvesting, silviculture, timber processing and related activities (Table 11). About half the workers associated with the harvesting and processing of the timber from this licence live in the Kootenay Lake TSA.

Table 11. Tembec's harvest and direct employment statistics

Allowable annual cut	115 216 cubic metres
Annual average harvest (1997-1999)	102 407 cubic metres
1999 harvest	112 437 cubic metres
Estimated employment (person-years)[a]	
Harvesting and administration	45-53
Log transport (included in harvesting and administration)	—
Road construction and maintenance	4-5
Silviculture	7-9
Timber processing	60-68
Total	116-135

Source: Ministry of Forests, Harvest Database.

(a) Estimates of employment are based on 1997-1999 average annual harvest of 102 407 cubic metres. Estimates are derived from information supplied by the licensee and include employment associated with TSA timber that is processed outside the TSA.

J. H. Huscroft Ltd.

J. H. Huscroft Ltd. (Huscroft) has a replaceable forest licence to harvest 78 644 cubic metres per year, resulting from the consolidation of an award of additional volume in December, 1997 with its forest licence. All the timber harvested from this licence is processed in the company's lumber mill in Erickson, within the Kootenay Lake TSA. Based on recent data, Huscroft's average annual harvest from this licence supported an estimated 133-142 person-years of employment in harvesting, silviculture, timber processing and related activities (Table 12). Almost all the workers associated with the harvesting and processing of the timber from this licence live in the Kootenay Lake TSA.

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Table 12. Huscroft's harvest and direct employment statistics

Allowable annual cut	78 644 cubic metres
Annual average harvest (1997-1999)	72 931 cubic metres
1999 harvest	68 584 cubic metres
Estimated employment (person-years)[a]	
Harvesting and administration	27-28
Log transport	6
Road construction and maintenance	6
Silviculture	9-10
Timber processing	85-92
Total	133-142

Source: Ministry of Forests, Harvest Database.

(a) Estimates of employment are based on 1997-1999 average annual harvest of 72 931 cubic metres. Estimates are derived from information supplied by the licensee and include employment associated with TSA timber that is processed outside the TSA.

Kalesnikoff Lumber Company Ltd.

Kalesnikoff Lumber Company Ltd. (Kalesnikoff) has a replaceable forest licence to harvest 55 247 cubic metres per year. This volume reflects the consolidation of an award of additional volume in December, 1997 with its forest licence. All the timber harvested from this licence is processed in the company's lumber mill in Thrums, located outside the Kootenay Lake TSA. Based on recent data, Kalesnikoff's average annual harvest from this licence supported an estimated 39-104 person-years of employment in harvesting, silviculture, timber processing and related activities (Table 13). About 15% of the workers associated with the harvesting and processing of the timber from this licence live in the Kootenay Lake TSA.

Table 13. Kalesnikoff's harvest and direct employment statistics

Allowable annual cut	55 247 cubic metres
Annual average harvest (1997-1999)	32 280 cubic metres
1999 harvest	53 616 cubic metres
Estimated employment (person-years)[a]	
Harvesting and administration	8-26
Log transport	2-8
Road construction and maintenance	6-13
Silviculture	1-3
Timber processing	22-54
Total	39-104

Source: Ministry of Forests, Harvest Database.

(a) Estimates of employment are based on 1997-1999 average annual harvest of 32 280 cubic metres. Estimates are derived from information supplied by the licensee and include employment associated with TSA timber that is processed outside the TSA.

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Kaslo and District Community Forest Society

The Kaslo and District Community Forest Society (Kaslo) has a non-replaceable forest licence to harvest 10 000 cubic metres per year. Harvesting of this licence has only begun recently. More than 85% of the volume harvested from this licence is processed at mills outside the Kootenay Lake TSA.

Based on recent data, Kaslo's average annual harvest from this licence supported an estimated 8-13 person-years of employment in harvesting, silviculture, timber processing and related activities (Table 14). About half of the workers associated with the harvesting and processing of the timber from this licence live in the Kootenay Lake TSA.

Table 14. Kaslo's harvest and direct employment statistics

Allowable annual cut	10 000 cubic metres
Annual average harvest (1998-1999)	6 322 cubic metres
1999 harvest	12 402 cubic metres
Estimated employment (person-years)[a]	
Harvesting and administration	1-6
Log transport (included in harvesting and administration)	1
Road construction and maintenance	< 1
Silviculture	0
Timber processing	5
Total	8-13

Source: Ministry of Forests, Harvest Database.

(a) Estimates of employment are based on 1998-1999 average annual harvest of 6322 cubic metres. Estimates are derived from information supplied by the licensee and include employment associated with TSA timber that is processed outside the TSA.

Meadow Creek Cedar Ltd.

Meadow Creek Cedar Ltd. (Meadow Creek) has a replaceable forest licence to harvest 96 513 cubic metres per year. About 60% of the harvested timber from this licence is processed in the TSA, including the company's lumber mill at Cooper Creek. Based on recent data, Meadow Creek's average annual harvest from this licence supported an estimated 116-165 person-years of employment in harvesting, silviculture, timber processing and related activities (Table 15). Almost 90% of the workers associated with the harvesting and processing of the timber from this licence live in the Kootenay Lake TSA.

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Table 15. Meadow Creek's harvest and direct employment statistics

Allowable annual cut	96 513 cubic metres
Annual average harvest (1997-1999)	88 220 cubic metres
1999 harvest	81 523 cubic metres
Estimated employment (person-years)[a]	
Harvesting and administration	28-35
Log transport (included in harvesting and administration)	10-12
Road construction and maintenance	1-15
Silviculture	13-16
Timber processing	64-87
Total	116-165

Source: Ministry of Forests, Harvest Database.

(a) Estimates of employment are based on 1997-1999 average annual harvest of 88 220 cubic metres. Estimates are derived from information supplied by the licensee and include employment associated with TSA timber that is processed outside the TSA.

Slocan Forest Products Ltd.

Slocan Forest Products Ltd. (Slocan) has a replaceable forest licence to harvest 65 155 cubic metres per year, not including 2427 cubic metres of undercut carried forward from previous years. Almost all of the timber harvested from this licence is processed outside the Kootenay Lake TSA, most of it at the company's lumber mill in Slocan. Based on recent data, Slocan's average annual harvest from this licence supported an estimated 72-118 person-years of employment in harvesting, silviculture, timber processing and related activities (Table 16). About one-third of the workers associated with the harvesting and processing of the timber from this licence live in the Kootenay Lake TSA.

Table 16. Slocan's harvest and direct employment statistics

Allowable annual cut	67 582 cubic metres
Annual average harvest (1997-1999)	68 321 cubic metres
1999 harvest	65 440 cubic metres
Estimated employment (person-years)[a]	
Harvesting and administration	25-44
Log transport (included in harvesting and administration)	6-9
Road construction and maintenance	7-21
Silviculture	2-3
Timber processing	32-41
Total	72-118

Source: Ministry of Forests, Harvest Database.

(a) Estimates of employment are based on 1997-1999 average annual harvest of 68 321 cubic metres. Estimates are derived from information supplied by the licensee and include employment associated with TSA timber that is processed outside the TSA.

Other licensees

Goose Creek Lumber Ltd. has a replaceable forest licence to harvest 10 000 cubic metres per year. Also, Creston Valley Forest Corporation has a non-replaceable forest licence to harvest 15 000 cubic metres per year. These two licences were recently awarded and therefore do not have a three-year history of harvesting and related activities. Nevertheless, the future employment and income effects of the harvests from these and all the other licences in the TSA have been incorporated into this analysis.

The Harrop-Proctor Community Forest Pilot Project is one of ten pilot tenures awarded by the Minister of Forests. Harvesting has not yet occurred, but a harvest rate of approximately 2220 cubic metres per year is anticipated. It is hoped that eco-certification and value-added manufacture will provide higher that normal levels of employment, but supporting data is not currently available.

Small Business Forest Enterprise Program

The apportioned volume in Kootenay Lake TSA's Small Business Forest Enterprise Program (SBFEP) is 143 010 cubic metres per year, or about 20% of the TSA's apportioned AAC. SBFEP harvests in recent years have averaged more than 92 000 cubic metres per year, or about 15% of the total annual harvest in the TSA. An estimated 40–45% of the timber harvested in the SBFEP is processed within the TSA. Based on averages of licensees and operators in the TSA, the volume harvested under the SBFEP supported an estimated 132-164 person-years of employment in harvesting, silviculture, timber processing and related activities (Table 17). From 1997 to 1999, registrants who reside within the Kootenay Lake TSA harvested an estimated 40% of the volume of timber that was harvested in the SBFEP.

Table 17. SBFEP's harvest and direct employment statistics

Allowable annual cut	143 010 cubic metres
Annual average harvest (1997-1999)	92 056 cubic metres
1999 harvest	84 808 cubic metres
Estimated employment (person-years)[a]	
Harvesting and administration	38-47
Log transport	7-9
Road construction and maintenance	10-12
Silviculture	8-10
Timber processing	69-86
Total	132-164

Source: Ministry of Forests, Harvest Database.

(a) Estimates of employment are based on 1997-1999 annual average harvest of 92 056 cubic metres. Estimates are derived from industry averages of licensees and operators in the TSA and include employment associated with TSA timber that is processed outside the TSA.

Kootenay Lake TSA timber supply and processing capacity

About 40–45% of the timber harvested in the Kootenay Lake TSA is processed within the TSA. Timber processing plants in the Kootenay Lake TSA include five lumber mills, two shake and shingle plant and one pole plant. These timber processing plants have an estimated annual processing capacity of about 600 000 cubic metres. Between 1997 and 1999, harvests in the TSA averaged less than 600 000 cubic metres per year. Some of the harvest in the TSA is transported out of the TSA to be processed. Therefore, additional timber supply for processing plants in the TSA comes from nearby TSAs, Tree Farm Licences (TFLs)*, as well as private sources (Table 18).

Table 18. Timber processing facilities and estimated annual capacities, Kootenay Lake TSA, 1999

Name	Type of mill	Location of mill	Estimated annual capacity ('000s m³)
Cooper Creek Cedar Ltd.	Lumber	Meadow Creek	75
Harvey Remple Sawmills Ltd.	Lumber	Meadow Creek	15
J.H. Huscroft Ltd.	Lumber	Erickson	130
J.R. Blackmore and Sons Ltd.	Pole	Kitchener	8
Kootenay Pride Shake & Shingle Ltd.	Shake & shingle	Meadow Creek	15
Meadow Creek Cedar Ltd.	Lumber	Cooper Creek	150
Remco Shake & Shingle Products Ltd.	Shake & shingle	Cooper Creek	10
Wynndel Box & Lumber Co. Ltd.	Lumber	Wynndel	185
Total			588

Sources: Ministry of Forests. 1999. Major primary timber processing facilities in British Columbia, 1999.
Additional information provided by operators in TSA.

Tree farm licence (TFL)
Provides rights to harvest timber, and outlines responsibilities for forest management, in a particular area.

7.2.4 Forestry sector employment and employment coefficients

Harvesting and employment information is used to estimate employment coefficients* which will be used to project future employment levels in the forestry sector. For this purpose, the forestry sector has been divided into three sub-sectors:

- harvesting and other woodlands-related employment such as log transportation, log salvage, log scaling and harvest planning and administration;
- silviculture employment such as planting, surveying and other basic and intensive silviculture activities, such as spacing, fertilization and pruning*; and
- primary timber processing employment, such as manufacturing activities at lumber mills, veneer and plywood mills, shake and shingle mills and pulp and paper mills.

Harvesting employment

The harvesting employment component is closely related to the volume that is harvested and is, therefore, the first sub-sector affected by changes in the TSA's harvest level. This sub-sector includes employees who work in the harvesting operations of a forest company as well as contract loggers. Harvesting activity in the Kootenay Lake TSA occurs mostly from June to February. Cable and ground-based harvesting systems are the main types of harvesting methods used.

Silviculture employment

The silviculture employment component is not as closely related to the AAC because time can elapse between when harvesting ends and when replanting the harvested areas begins[2]. Basic silviculture consists of surveys, site preparation, planting, brushing, cone collection and spacing. Enhanced silviculture includes spacing, fertilization and pruning. In the Kootenay Lake TSA, licensees are responsible for basic silviculture on areas harvested under major licences. The provincial government is responsible for all enhanced silviculture and the remaining basic silviculture on Crown land.

Employment coefficient
The number of person-years of employment supported by every 1000 cubic metres of timber harvested; for example, a coefficient of 1.0 indicates that every 1000 cubic metres harvested supports one person-year, or 500 000 cubic metres supports 500 person-years.

Primary timber processing employment

The timber harvested from the Kootenay Lake TSA is processed into a variety of products such as lumber, panel products, log homes, poles and posts, shakes and shingles, and pulp at mills within the TSA and in neighbouring TSAs. Mills in the TSA also process timber that is harvested from other TSAs and private sources.

Ministry of Forests employment

About 54 people work in the Kootenay Lake Forest District office. The Nelson Forest Region's office is also located with the Kootenay Lake TSA and approximately 100 people work in this office. District staff oversee the management of forestry-related activities on Crown land in the Kootenay Lake TSA. Employment in the Ministry of Forests is not included as part of direct employment in the forestry sector because its activities are more related to the implementation of government policy than to the timber harvest and would not be affected by marginal changes in the timber supply. Ministry employees are, nevertheless, an important part of total employment in the TSA and are accounted for in the government services component of the TSA's economic base.

Pruning
The manual removal of the lower branches of crop trees to a predetermined height to produce clear, knot-free wood.

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(2) In addition to replanting the harvested area, there are requirements for the harvested stand to be re-established, first to a green-up state and then to a free-to-grow state. The time that it takes for a replanted area to reach green-up state varies, depending on the requirements for visual, hydrological and wildlife resource values. The height requirement for replanted stands can vary among different resource zones. The time required for the replanted stands to reach the free-to-grow state (when the planted commercial species are as high or higher than competing non-commercial species or brush vegetation) varies according to the silvicultural system used and the ecological association of the stand. Experience indicates that this period can range from 7 to 20 years after harvest. Silviculture activity in harvested areas continues until the stand reaches the free-to-grow state.

Employment coefficients

Employment coefficients, expressed as person-years of employment per 1000 cubic metres of harvest, have been calculated using employment information from licensees and operators. Table 19 summarizes employment supported by the 1997-1999 harvests in the Kootenay Lake TSA and the corresponding employment coefficients. The employment and coefficients are separated into two groups:

1) TSA employment and employment coefficients, which comprise residents of the Kootenay Lake TSA who are employed in the forestry sector within the Kootenay Lake TSA; and
2) Provincial employment and employment coefficients, which comprise all forestry sector employment in the province that relies on the Kootenay Lake TSA timber supply, including both residents of the Kootenay Lake TSA and those who live elsewhere.

Calculations have been made for both groups to identify the importance of the forestry sector within the Kootenay Lake TSA and to highlight the contribution that the Kootenay Lake TSA's forestry sector makes to the provincial economy. Employment is divided into direct, indirect and induced components; the sum of the components is the total impact, expressed as the number of full-time jobs per 1000 cubic metres of timber harvested or processed. Indirect and induced employment figures were derived using employment multipliers developed by the Ministry of Finance and Corporate Relations.

The 1994 *Kootenay Lake Timber Supply Area Socio-Economic Analysis* reported that the 1988-1992 five-year average harvest of 604 000 supported an estimated 538 person-years of direct forestry employment in the province. This result indicated a provincial employment coefficient of 0.89 person-years of direct employment per 1000 cubic metres.

The current Timber Supply Review shows that harvesting, silviculture and timber processing activities associated with Kootenay Lake TSA's 1997-1999 average annual harvest of about 603 000 cubic metres supported an estimated 871 person-years of direct employment in the province. This outcome indicates a provincial employment coefficient of 1.44 person-years of direct employment per 1000 cubic metres[3] (Table 19).

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(3) Differences in employment coefficient ratios can be due to several reasons: (1) different sources of information; (2) different methods of calculation; (3) reference to employment at different harvest levels; (4) different definitions of full-time employment; and (5) different definitions of forestry sub-sectors. Regardless of which definitions are used, the resulting estimates of impacts of harvest level changes should illustrate similar effects.

Table 19. Forestry sector employment and employment coefficients, Kootenay Lake TSA[a]

Activity	**Within TSA**		**Province**	
	TSA employment (person-years)	**TSA employment coefficient (person-years per '000s m³)**	**Province employment (person-years)**	**Province employment coefficient (person-years per '000s m³)**
Harvesting	266	0.44	322	0.53
Silviculture	46	0.08	55	0.09
Timber processing	263	0.44	494	0.82
Total direct employment	575	0.95	871	1.44
Indirect + induced employment	307	0.51	1,099	1.82
Total	882	1.46	1,970	3.26

(a) Employment estimates are reported in person-years (PY) and are based on 1997-1999 average employment and harvest in the Kootenay Lake TSA. Due to rounding, some totals may not equal the sum of their components.

For a more detailed discussion regarding employment coefficients, see Appendix B, "Socio-Economic Analysis Background Information."

7.2.5 Forestry sector employment income

In 1999, the average annual income of forestry employees was $46,956 for those working in logging and forestry services; $44,980 for those working in solid wood manufacturing; and $58,136 for those working in pulp and paper mills. For workers in indirect and induced employment (such as construction, business services, retail trade, etc.), the estimated average annual income in 1999 was $30,732. Based on 1997-1999 annual averages, the Kootenay Lake TSA's timber harvest supported about $40.9 million in direct employment income and an additional $30.3 million of indirect and induced employment income. In all, the harvest supported an estimated total of $74.2 million in employment income, or more than $123,000 per 1000 cubic metres harvested (Table 20).

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Table 20. Estimate of forestry sector provincial employment income, Kootenay Lake TSA[a]

Employment component	Estimated person-years of employment	Estimated annual income per worker ($)	Total employment income ($ million)	Employment income ($ per '000s m³)
Direct employment				
Logging and forestry services	378	46,844	17.66	29,290
Solid wood processing	449	46,183	20.74	34,392
Pulp and paper processing	45	55,931	2.52	4,174
Subtotal	872		40.92	67,856
Indirect + induced employment	1,099	30,320	33.32	55,265
Total	1,971		74.24	123,121

Source: Statistics Canada. Survey of employment, payroll and hours. 1997 to 1999 data.

(a) Estimates based on 1997-1999 average annual harvest of 602 940 cubic metres. Due to rounding, some totals may not equal the sum of their components.

7.2.6 Provincial government revenues

The provincial government receives taxes and revenues from the forest industry. The forest industry pays stumpage, royalties and rent to the provincial government for the right to harvest and use timber. The forest industry also pays operating taxes such as logging, corporate income, property and sales taxes. As well, the provincial and federal governments receive revenues from forestry employees through income taxes.

Between 1997 and 1999, the timber harvest in the Kootenay Lake TSA contributed about $7.8 million in stumpage and rent payments annually to the provincial government. Other taxes paid by the forest industry, such as logging, corporate income, property and sales taxes, contributed about $4.7 million annually. In addition, the provincial government received about $6.4 million in income taxes paid by forestry sector employees (Table 21). Altogether, the timber harvest in the Kootenay Lake TSA contributed an estimated $18.8 million to provincial government revenues.

Table 21. Estimate of average annual provincial revenues, 1997-1999, Kootenay Lake TSA

Provincial revenues from:	Average annual volume harvested (m^3)	Average annual provincial revenues ($ million)	Average annual provincial revenue ($ per '000s m^3)
Stumpage and related revenues[a]	602 940	7.80	12,940
Forest industry taxes[b]	602 940	4.66	7,729
Employment income taxes[c]	602 940	6.37	10,570
Total	602 940	18.83	31,239

(a) Source: Ministry of Forests, Revenue Branch.

(b) Based on estimates by PriceWaterhouseCoopers, and includes taxes for logging, corporate income, corporate capital, sales, property and electricity.

(c) Estimated from Revenue Canada income tax rates and includes only the provincial share of income taxes paid.

7.3 Implications of the base case harvest forecast

The socio-economic analysis focuses on harvest level changes in the short- to medium-term of 10-30 years from now and considers:

- the implications of alternative harvest levels for both the Kootenay Lake TSA and the province;
- possible impacts on the communities within the TSA;
- log supply requirements of timber processing facilities within the Kootenay Lake TSA; and
- regional timber supply implications.

The socio-economic analysis considers average levels of forestry activity that the base case harvest forecast could support, assuming that the current role of the forestry sector in the provincial economy continues and that labour productivity does not change. The analysis also assumes that the proportions of harvesting, silviculture and timber processing employment remain constant and that the types and portions of wood products manufactured remain the same.

Employment impacts associated with future harvest levels are calculated using employment coefficients (person-years of employment per 1000 cubic metres). This method of calculating employment coefficients assumes that employment levels in the future can be predicted using current conditions of employment and the volume of timber harvested or processed. While this method can be reasonably accurate for short-term forecasts (within the next 3-5 years), employment coefficients 20 years from now may be very different due to changes in forest products market conditions and timber processing technologies, for example. The analysis indicates the size of impacts on employment, employment income and provincial government revenues, within a constantly changing socio-economic environment.

The base case harvest forecast for the Kootenay Lake TSA

The base case harvest forecast for the next five decades is 691 000 cubic metres per year, which after accounting for issued woodlot licences, is 9000 cubic metres less than the current AAC.

7.3.1 Employment and employment income impacts within the Kootenay Lake TSA

Using 1997-1999 annual averages, the base case harvest forecast of 691 000 cubic metres per year for the next five decades will support an estimated 1,024 person-years of employment (direct, indirect and induced) in the TSA. Employment will likely be close to current levels as companies respond to market changes and adjust harvesting activities under cut control regulations. Employment income generated in the Kootenay Lake TSA is estimated to be $41.34 million.

7.3.2 Employment and employment income impacts in the province

Provincial employment includes all forestry sector employment supported by the timber harvested from the Kootenay Lake TSA. Over the next five decades the base case harvest forecast will annually support an estimated 2,258 person-years of employment in the province and generate an estimated $85.08 million in employment income (Table 22).

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Table 22. Socio-economic impacts of Kootenay Lake TSA base case harvest forecast

Harvesting activity	Current AAC[a] ('000s m^3)	Base case harvest forecast decades 1 to 5 ('000s m^3)
Current AAC/forecast timber supply	700.0	691.0
Harvest level (1997-1999 average)	602.9	
Difference from current AAC	– 97.1	– 8.9
Kootenay Lake Timber Supply Area		
Employment	(person-years)	(person-years)
Direct	668	659
Indirect + induced	356	352
Total	1,024	1,011
Range of employment gain[b] or (loss)		(11 – 13)
Employment income	($ millions)	($ millions)
Direct	31.07	30.67
Indirect + induced	10.81	10.67
Total	41.88	41.34
Range of income gain (loss) compared with AAC		($0.48 – $0.53)
Province[c] (including Kootenay Lake TSA)		
Employment	(person-years)	(person-years)
Direct	1,011	998
Indirect + induced	1,276	1,260
Total	2,287	2,258
Range of employment gain or (loss)		(24 – 29)
Employment income	($ millions)	($ millions)
Direct	47.50	46.89
Indirect + induced	38.68	38.19
Total	86.18	85.08
Range of income gain (loss) compared with AAC		($0.96 – $1.10)
Provincial government revenues	($ millions)	($ millions)
Stumpage & related payments	9.06	8.9
Forest industry taxes	5.41	5.34
Employee income taxes	7.40	7.30
Total	21.87	21.59
Gain (reduction) in revenues compared to current AAC		($0.27 – $0.28)

(a) Estimates of employment in this table differ from those in Tables 19-21. Employment estimates in this table are based on the current AAC of 700 000 cubic metres, while the estimates in Tables 19-21 are based on the 1997-1999 average annual harvest volume of 602 940 cubic metres. Due to rounding, some totals may not equal the sum of their components.

(b) The ranges for employment and income changes consider employment insurance and other social assistance programs that give temporary short-term income to unemployed or displaced workers. The range's upper limit assumes that all those who are unemployed or displaced will leave the TSA to seek opportunities elsewhere and will no longer spend their income locally, thus imparting a higher impact on the local economy than if they had not left. The range's lower limit assumes that employment insurance and other social assistance payments to unemployed or displaced workers will temporarily encourage them not to leave the community, thus reducing the induced impacts of a lower harvest level. The actual impacts of changes in harvest levels on employment and incomes will likely fall within the specified ranges. See Appendix B for additional explanations.

(c) Estimates of TSA employment and income impacts are included as part of the estimates of provincial employment and income impacts.

7.3.3 Provincial government revenues

Provincial government revenues from the harvest of the current AAC are estimated to be $21.86 million annually. The base case harvest forecast of 691 000 cubic metres per year for the next five decades will generate, on average, an estimated $21.59 million annually in provincial government revenues. Assuming that there will be no changes to tax rates or to stumpage-related charges and provided that the entire volume is harvested and fully utilized, annual provincial government revenues will decrease by less than $300,000 from the current level.

7.3.4 Community impacts

The impacts of short- and long-term changes in timber supply will be much greater on an economy that depends on the local timber supply than on one that is more diversified. The base case harvest forecast indicates that the current harvest level can be maintained for the next four decades indicating the ability to maintain the existing level of forestry activity in the Kootenay Lake TSA.

7.3.5 Log supply requirements of timber processing facilities in the Kootenay Lake TSA

Between 1997 and 1999, harvests in the Kootenay Lake TSA averaged about 604 000 cubic metres per year. About 45% of the timber from harvest was processed within the TSA. The estimated timber processing capacity in the Kootenay Lake TSA is about 600 000 cubic metres per year. Additional timber supplies are from nearby TSAs and private sources.

7.3.6 Regional timber supply issues

The movement of timber across forest district boundaries means that communities in the Kootenay Lake TSA can be vulnerable to timber supply changes in other districts. Information from previous Timber Supply Reviews indicated that the timber supply in this part of the Kootenay region could decline by about 20% or almost 433 000 cubic metres by the year 2017.[4] Since mills in the Kootenay Lake TSA depend on neighbouring management units (including private sources) for about 25% of their timber supply, future reductions in neighbouring timber supply areas could affect the timber supply available to these mills. However, this outlook may change as each successive Timber Supply Review re-examines the timber supply in the region. The *Kootenay-Boundary Land Use Plan* may have further implications for communities as the timber supply adjusts to meet the objectives of the plan. How these processes may eventually impact the Kootenay Lake TSA will depend on the actual timber supply changes, the composition of the industry and timber flows at the time.

7.4 Summary

Forestry and mining are the major resource sectors in the Kootenay Lake TSA's economy. Major forest licence holders in the TSA include Atco Lumber Ltd., Celcrest Timber Ltd. and Wynndel Box & Lumber Company Ltd., Tembec Industries Inc., Creston Valley Forest Corporation, Goose Creek Lumber Ltd., J.H. Huscroft Ltd., Kalesnikoff Lumber Company Ltd., Meadow Creek Cedar Ltd., and Slocan Forest Products Ltd. Together, these licensees account for more than 75% of the apportioned volume in the TSA. The Ministry of Forests' Small Business Forest Enterprise Program accounts for an additional 20%. Primary timber processing plants include five lumber mills, two shake and shingle plants and one pole plant.

The base case harvest forecast for the Kootenay Lake TSA indicates a harvest level of 691 000 cubic metres per year for the next five decades. This level of harvest activity could support an estimated 2,258 person-years of forestry employment (includes direct, indirect and induced jobs) and generate $85.08 million of employment income in the province. An estimated $21.59 million per year in provincial government revenues would be generated. Within the Kootenay Lake TSA, the timber supply as projected in the base case harvest forecast could support an estimated 1,024 person-years of employment annually and generate an estimated $41.88 million in employment income.

The base case harvest forecast indicates some stability at the present level of forestry activity in the Kootenay Lake TSA. This may allow the industry to maintain its current level of operations from a timber supply perspective.

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(4) These estimates are based on the most recent Timber Supply Review's base case forecasts for Kootenay Lake, Arrow and Cranbrook TSAs. The combined timber supply volume for these management units is currently 2.17 million cubic metres per year. The harvest level is forecast to be 1.74 million cubic metres per year by 2017.

8 References

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Allowable annual cut (AAC)	The rate of timber harvest permitted each year from a specified area of land, usually expressed as cubic metres of wood per year.
Available volumes	The portion of total inventory volumes that is available for harvesting after all management constraints on timber harvesting have been considered, including definition of the timber harvesting land base, age of tree merchantability, deferrals, and any other priorities or constraints on timber harvesting.
Base case harvest forecast	The timber supply forecast which illustrates the effect of current forest management practices on the timber supply using the best available information, and which forms the reference point for sensitivity analysis.
Biodiversity (biological diversity)	The diversity of plants, animals and other living organisms in all their forms and levels of organization, including the diversity of genes, species and ecosystems, as well as the evolutionary and functional processes that link them.
Biogeoclimatic (BEC) variant	A subdivision of a biogeoclimatic zone. Variants reflect further differences in regional climate and are generally recognized for areas slightly drier, wetter, snowier, warmer or colder than other areas in the subzone.
Biogeoclimatic zones	A large geographic area with broadly homogeneous climate and similar dominant tree species.
Clearcut harvesting	A harvesting method in which all trees are removed from an area of land in a single harvest. The harvested site is then regenerated to acceptable standards by appropriate means including planting and natural seeding. Note that retention of some live trees and snags for purposes of biodiversity now occurs on most clearcuts.
Cutblock	A specific area, with defined boundaries, authorized for harvest.
Cutblock adjacency	The desired spatial relationship among cutblocks. Most adjacency restrictions require that recently harvested areas must achieve a desired condition (green-up) before nearby or adjacent areas can be harvested. Specifications for the maximum allowable proportion of a forested landscape that does not meet green-up requirements are used to approximate the timber supply impacts of adjacency restrictions.

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Drainage	The surface and sub-surface water derived within a clearly defined catchment area, usually bounded by ridges or other similar topographic features, encompassing part, most, or all of a watershed. The term is sometimes used to describe an operating area or location.
Early seral	Stands are defined as early seral if they are younger than 40 years of age. An exception is deciduous-dominated stands in the Boreal White and Black Spruce biogeoclimatic zone, which are defined as early seral up to 20 years of age.
Employment coefficient	The number of person-years of employment supported by every 1000 cubic metres of timber harvested; for example, a coefficient of 1.0 indicates that every 1000 cubic metres harvested supports one person-year, or 500 000 cubic metres supports 500 person-years.
Employment multiplier	An estimate of the total employment supported by each direct job, for example a multiplier of 2.0 means that one direct job supports one additional indirect and induced job.
Environmentally sensitive areas	Areas with significant non-timber values, fragile or unstable soils, impediments to establishing a new tree crop, or high risk of avalanches.
Forest cover objectives	Specify desired distributions of areas by age or size class groupings. These objectives can be used to reflect desired conditions for wildlife, watershed protection, visual quality and other integrated resource management objectives. General adjacency and green-up guidelines are also specified using forest cover objectives (see **Cutblock adjacency and Green–up**).
Forest cover requirements	Specify desired distributions of areas by age or size class groupings. These objectives can be used to reflect desired conditions for wildlife, watershed protection, visual quality and other integrated resource management objectives. General adjacency and green-up guidelines are also specified using forest cover objectives (see **Cutblock adjacency and Green–up**).
Forest inventory	An assessment of British Columbia's timber resources. It includes computerized maps, a database describing the location and nature of forest cover, including size, age, timber volume, and species composition, and a description of other forest values such as recreation and visual quality.

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Forest Practices Code	Legislation, standards and guidebooks that govern forest practices and planning, with a focus on ensuring management for all forest values.
Free-growing	An established seedling of an acceptable commercial species that is free from growth-inhibiting brush, weed and excessive tree competition.
Green-up	The time needed after harvesting for a stand of trees to reach a desired condition (usually a specific height) — to ensure maintenance of water quality, wildlife habitat, soil stability or aesthetics — before harvesting is permitted in adjacent areas.
Growing stock	The volume estimate for all standing timber at a particular time.
Harvest forecast	The flow of potential timber harvests over time. A harvest forecast is usually a measure of the maximum timber supply that can be realized over time for a specified land base and set of management practices. It is a result of forest planning models and is affected by the size and productivity of the land base, the current growing stock, and management objectives, constraints and assumptions.
Higher level plans	Higher level plans establish the broader, strategic context for operational plans, providing objectives that determine the mix of forest resources to be managed in a given area.
Indirect and induced jobs	Indirect jobs are supported by direct business purchases of goods and services. Induced jobs are supported by employee purchases of goods and services; for example, at retail outlets.
Integrated resource management (IRM)	The identification and consideration of all resource values, including social, economic and environmental needs, in resource planning and decision-making.
Landscape-level biodiversity	The *Landscape Unit Planning Guide* provides objectives for maintaining biodiversity at both the landscape level and the stand level. At the landscape level, guidelines are provided for the maintenance of seral stage distribution, patch size distribution and landscape connectivity.
Landscape unit	A planning area based on topographic or geographic features, that is appropriately sized (up to 100 000 hectares), and designed for application of landscape-level biodiversity objectives.
Long-term harvest level	A harvest level that can be maintained indefinitely given a particular forest management regime (which defines the timber harvesting land base, and objectives and guidelines for non-timber values) and estimates of timber growth and yield.

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Mature seral	Forest stands with trees between 80 and 120 years old, depending on species, site conditions and biogeoclimatic zone.
Management assumptions	Approximations of management objectives, priorities, constraints and other conditions needed to represent forest management actions in a forest planning model. These include, for example, the criteria for determining the timber harvesting land base, the specification of minimum harvestable ages, utilization levels, integrated resource guidelines and silviculture and pest management programs.
Mean annual increment (MAI)	Stand volume divided by stand age. The age at which average stand growth, or MAI, assumes its maximum is called the culmination age. Harvesting all stands at this age results in a maximum average harvest over the long term.
Model	An abstraction and simplification of reality constructed to help understand an actual system or problem. Forest managers and planners have made extensive use of models, such as maps, classification systems and yield projections, to help direct management activities.
Natural disturbance type (NDT)	An area that is characterized by a natural disturbance regime, such as wildfires, which affects the natural distribution of seral stages. For example areas subject to less frequent stand-initiating disturbances usually have more older forests.
Old seral	Old seral refers to forests with appropriate old forest characteristics. Ages vary depending on forest type and biogeoclimatic variant.
Operability	Classification of an area considered available for timber harvesting. Operability is determined using the terrain characteristics of the area as well as the quality and quantity of timber on the area.
Partial retemtion VQO	Alterations may be visible but not conspicuous. Up to 15% of the area can be visibly altered by harvesting activity (see **Visual quality objective**).
Person-year(s)	One person working the equivalent of one full year, defined as at least 180 days of work. Someone working full-time for 90 days accounts for 0.5 person-years.

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Protected area	A designation for areas of land and water set aside to protect natural heritage, cultural heritage or recreational values (may include national park, provincial park, or ecological reserve designations).
Pruning	The manual removal of the lower branches of crop trees to a predetermined height to produce clear, knot-free wood.
Regeneration delay	The period of time between harvesting and the date at which an area is occupied by a specified minimum number of acceptable well-spaced trees.
Retention VQO	Alterations are not easy to see. Up to 5% of the visible landscape can be altered by harvesting activity (see **Visual quality objective**).
Riparian area	Areas of land adjacent to wetlands or bodies of water such as swamps, streams, rivers or lakes.
Scenic area	Any visually sensitive area or scenic landscape identified through a visual landscape inventory or planning process carried out or approved by a district manager.
Sensitive terrain areas	Areas with moderate to high potential for landslide initiation during timber harvesting or road construction, which therefore require special forest practices to ensure adequate site protection.
Sensitivity analysis	A process used to examine how uncertainties about data and management practices could affect timber supply. Inputs to an analysis are changed, and the results are compared to a baseline or base case.
Seral stages	Sequential stages in the development of plant communities that successively occupy a site and replace each other over time.
Site index	A measure of site productivity. The indices are reported as the average height, in metres, that the tallest trees in a stand are expected to achieve at 50 years (age is measured at 1.3 metres above the ground). Site index curves have been developed for British Columbia's major commercial tree species.
Stand-level biodiversity	A stand is a relatively localized and homogeneous land unit that can be managed using a single set of treatments. In stands, objectives for biodiversity are met by maintaining specified stand structure (wildlife trees or patches), vegetation species composition and coarse woody debris levels.

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Stocking	The proportion of an area occupied by trees, measured by the degree to which the crowns of adjacent trees touch, and the number of trees per hectare.
Timber harvesting land base	Crown forest land within the timber supply area where timber harvesting is considered both acceptable and economically feasible, given objectives for all relevant forest values, existing timber quality, market values and applicable technology.
Timber supply	The amount of timber that is forecast to be available for harvesting over a specified time period, under a particular management regime.
Timber supply area (TSA)	An integrated resource management unit established in accordance with *Section 7* of the *Forest Act*.
Table Interpolation Program for Stand Yields	A B.C. Forest Service computer program used to generate yield projections for managed stands using a model that simulates the growth of individual trees based on internal growth processes, crown competition, environmental factors and silvicultural practices.
Tree farm licence (TFL)	Provides rights to harvest timber, and outlines responsibilities for forest management, in a particular area.
Uneconomic areas	Areas defined as unavailable for harvest for economic or terrain-related reasons. Characteristics used in defining uneconomic areas include distance from processing facilities, existing roads, difficulty of road access, and availability of suitable timber. Areas considered uneconomic can change over time as a function of changing harvesting technology and economics.
Ungulate	A hoofed herbivore, such as deer.
Unsalvaged losses	The volume of timber killed or damaged annually by natural causes (e.g., fire, wind, insects and disease) and not harvested.
Variable Density Yield Prediction model	An empirical yield prediction system supported by the B.C. Forest Service, designed to predict average yields and provide forest inventory updates over large areas (i.e., Timber Supply Areas). It is intended for use in unmanaged natural stands of pure or mixed composition.
Visual quality objective (VQO)	Defines a level of acceptable landscape alteration resulting from timber harvesting and other activities. A number of visual quality classes have been defined on the basis of the maximum amount of alteration permitted.

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Volume estimates (yield projections)	Estimates of yields from forest stands over time. Yield projections can be developed for stand volume, stand diameter or specific products, and for empirical (average stocking), normal (optimal stocking) or managed stands.
Watershed	An area drained by a stream or river. A large watershed may contain several smaller watersheds.
Wildlife tree	A standing live or dead tree with special characteristics that provide valuable habitat for conservation or enhancement of wildlife.
Woodlot licence	An agreement entered into under the *Forest Act*. It allows for small-scale forestry to be practised in a described area (Crown and private) on a sustained yield basis.

Appendix A

Description of Data Inputs and Assumptions for the Timber Supply Analysis

Introduction

The following tables and discussion outline the methods and inputs used to derive the timber harvesting land base, and to construct the timber supply model for the Kootenay Lake TSA timber supply analysis. This information represents current forest management in the area.

Current management is defined as the set of land-use decisions and forest and stand management practices currently implemented and enforced. Future forest management objectives that may be intended, but are not currently implemented and enforced, are not included in this appendix.

The purpose of the Timber Supply Review is to provide information on the effects of current management on both short- and long-term timber supply in each timber supply area in the province. Any changes in forest management objectives and practices, and any improvements to the data will be included in subsequent timber supply analyses.

Most of the information in this appendix was excerpted from the May 1999 *Kootenay Lake Timber Supply Area Timber Supply Review Data Package,* any changes to the information specified in that document are discussed.

A.1 Inventory Information

Table A-1. Inventory information

Data	Source	Vintage	Update	Source scale
TSA forest inventory (fc1) files	Ministry of Forests (MoF)	1969, 1973	1997	1:20,000
Biogeoclimatic classification	MoF Research Branch	1993	1997	1:250,000
Caribou habitat (KBLUP)	MoF district non-standard overlay	1995	N/A	1:50,000
Ungulate winter habitat (non-caribou)	Ministry of Environment, Lands and Parks (MELP) district non-standard overlay, updated from KBLUP	1989	1998	1:50,000
Community and domestic watersheds	MELP non-standard overlay	1997	N/A	1:50,000
Landscape unit boundaries	MoF district non-standard overlay	1996	1998	1:250,000
Archaeological overview assessment	MoF — printed report	1996	N/A	1:50,000
Recreation inventory	MoF — non-standard overlay	1990	N/A	1:20,000
Visual landscape inventory	MoF district non-standard inventory files	1993	1998	1:50,000
Riparian management area classification	MoF district non-standard overlay	1997	N/A	1:50,000
Operating areas	MoF district non-standard overlay	1993	1997	1:250,000
Terrain class (levels B, D)	MoF district non-standard overlay	1995-1997	N/A	1:20,000
British Columbia watershed atlas	MoF region non-standard overlay	1996	N/A	1:50,000

Note: N/A in this table denotes that the information has not been updated since the original collection.

Data source and comments:

Timber supply area (TSA) forest inventory (.fc1) files were updated for disturbance to September 1997 and the database was projected for growth and aging to January 1998.

Caribou habitat management areas are consistent with the KBLUP. Ungulate winter habitat has been identified on 1:50 000 scale maps completed in 1989 and updated in 1998. These maps provide superior resolution to the 1:250 000 ungulate winter range (UWR) KBLUP mapping.

Landscape unit boundaries and associated biodiversity emphasis options (BEO) were legally established July 1, 1998.

Visual landscape inventories were completed for the Kootenay Lake Forest District in both 1991 and 1993, and updated in 1998.

A.1 Inventory Information

The May 1999 data package listed old-seral patches in this table and indicated a sensitivity analysis of old-seral patches (OSPs) identified for consideration as old-growth management areas (OGMAs) would be conducted. Upon review of the extent of the information available it was determined a sensitivity analysis would not be worthwhile

Licensee operating areas were reviewed in 1997. The operating areas digital file was incorporated into the data set to allow for additional analysis after the timber supply review (TSR).

Drainage boundaries from the *British Columbia Watershed Atlas* were used as a basis for applying forest cover requirements on a geographic basis.

A.2 Zone and Analysis Unit Definition

A.2.1 Management zones (groupings) and objectives

Table A-2. Objectives to be tracked

Objectives	Inventory definition
Landscape-level biodiversity	Established landscape units and biodiversity emphasis options and associated old and old plus mature seral stage targets as per the *Biodiversity Guidebook* and the *Kootenay-Boundary Land Use Plan* (KBLUP).
Caribou management	Age class 8 and 9 (over 140 years old) area targets specified in the KBLUP for ICH and ESSF biogeoclimatic zones within identified caribou management areas.
Ungulate winter range (UWR) habitat cover requirements	Updated KBLUP ungulate winter range mapping.
Visual quality management	Visual quality classifications contained within the 1993 Kootenay Lake Forest District visual landscape inventory (reflect current management direction to licensees).
Community / domestic watershed management	Community and domestic watershed mapping and guidelines.
Integrated resource management objective	Areas where harvesting operations are not otherwise constrained by other cover objectives.

Data source and comments:

See Section A.1, "Inventory information" for the sources of the inventories referenced above.

A.2 Zone and Analysis Unit Definition

A.2.2 Analysis unit characteristics

Table A-3. Definition of analysis units

Status	Species group	Site index group	Age group	Analysis unit number	Initial timber harvesting land base (hectares)	Inventory type groups
Existing	FD	> 20	> 140	1111	348	F, FC, FH, FS, FP1, FPy, FL, FDecid, Py, LF, E, AtDecid (1–8, 32–34, 40, 42)
			1–140	1112	37 643	
		14–20	> 140	1121	3 655	
			1–140	1122	39 064	
		< 14	> 140	1131	1 134	
			1–140	1132	4 658	
	CH	> 20	> 140	1211	386	C, CF, CH, H, HF, HC, HB, HS, Hdecid (9–17)
			1–140	1212	2 241	
		14–20	> 140	1221	7 126	
			1–140	1222	5 781	
		< 14	> 140	1231	11 228	
			1–140	1232	3 983	
	BS	> 20	> 140	1311	548	B, BH, BS, S, SF, SH, SB, S, SF, SH, SB, SPl, Sdecid (18–26)
			1–140	1312	3 258	
		14–20	> 140	1321	5 055	
			1–140	1322	15 033	
		< 14	> 140	1331	17 900	
			1–140	1332	8 496	
	Pl	> 20	> 140	1411	59	Pl, Pw, PlF, PlS, PlDeciduous, AtConif (27–31, 41)
			1–140	1412	11 675	
		14–20	> 140	1421	409	
			1–140	1422	45 107	
		< 14	> 140	1431	944	
			1–140	1432	5 822	
Managed	FD	> 20	N/A	2110	370	F, FC, FH, FS, FP1, FPy, FL, FDecid, Py, LF, E, AtDecid (1–8, 32–34, 40, 42)
		14–20	N/A	2120	3 128	
		< 14	N/A	2130	756	
	CH	> 20	N/A	2210	242	C, CF, CH, H, HF, HC, HB, HS, Hdecid (9–17)
		14–20	N/A	2220	1 499	
		< 14	N/A	2230	469	
	BS	> 20	N/A	2310	116	B, BH, BS, S, SF, SH, SB, S, SF, SH, SB, SPl, Sdecid (18–26)
		14–20	N/A	2320	12 265	
		< 14	N/A	2330	3 092	
	Pl	> 20	N/A	2410	399	Pl, Pw, PlF, PlS, PlDeciduous, AtConif (27–31, 41)
		14–20	N/A	2420	3 471	
		< 14	N/A	2430	490	

A.3 Definition of the Timber Harvesting Land Base

A.3.1 Land not administered by the British Columbia Forest Service

The ownership (OWNER and OWNR_CH) codes on the inventory file were used to determine areas not managed by the B.C. Forest Service for timber supply. This category may include parks, ecological reserves, private land and various special use permit areas. Forest with ownership codes 62 C (forest management unit) or 69 C (forest reserves) contribute to the TSA timber supply.

After the release of the data package, areas with ownership code 61 C (UREP) were recognized as contributing to the timber harvesting land base while areas identified with any of the following woodlot licence identifiers (WL1458, WL1460, WL1461, WL1670, WL1776, WL1778, WL1864, WL435, WL436, WL437, WL438, WL439, WL491, WL494) and area labelled with operator code 'PAS' within landscape unit K7 were excluded from the timber harvesting land base.

Since the previous AAC determination, eight new woodlots covering 4800 gross hectares have been issued. In addition, five woodlots, which existed as of the previous AAC determination have been expanded by 1074 gross hectares. The AAC associated with these new issues and expansions is 8535 cubic metres per year and 372 cubic metres per year respectively, for a total of 8907 cubic metres per year.

The Harrop-Procter Community Forest Pilot Project was recently initiated, which covers an area of approximately 10 600 gross hectares. This area is still within the TSA land base.

A.3.2 Non-productive forest and non-forest land

Non-forest, non-productive forest (TYPID_PR = 6) and non-typed (TYPID_PR = 8) areas do not contribute to timber harvesting. These categories include areas covered by such things as sparse alpine forest, ice, swamps, water, and rock.

A.3.3 Non-commercial (brush) forest cover

Non-commercial brush types (TYPID_PR = 5), were not included in the timber harvesting land base.

A.3.4 Environmentally sensitive areas

Some forest lands are environmentally sensitive and/or significantly valuable for other resources and excluded from timber harvesting. These areas are identified and delineated during a forest inventory and are called environmentally sensitive areas (ESAs). The ESA system employs the following categories: soil (Es), forest regeneration problems (Ep), snow avalanche (Ea), recreation (Er), wildlife (Ew), water (Eh). Two ESA classes are recognized within each category: high (1) and moderately sensitive (2). Land base reductions were only made for areas classified with high sensitivity (ESA 1). The following table lists the per cent of the area classified that was excluded from the timber harvesting land base.

A.3 Definition of the Timber Harvesting Land Base

Table A-4. Per cent of area considered unavailable for timber harvesting

ESA category	ESA description	Reduction per cent (%)
Es	Soil sensitivity	0[a]
Ep	Regeneration problems	90
Eh	Water quality	0[a]
Er	Recreation sensitivity	50[b]
Ew	Wildlife habitat	0[a]
Ea	Snow avalanche hazard	100

(a) Areas of high soil, water quality and wildlife habitat sensitivity are accounted for in the analysis by using alternative information identified in the inventories section (Section A.1).

(b) After the data package was released, it was determined that recreation reductions were not required in the following landscape units due to overlap with riparian management zones and visual quality objectives, therefore no reductions were made (K1, K6, K12, K15, K16, K17, K21, K24).

A.3.5 Terrain stability mapping for soils

Level B (detailed) and D (reconnaissance) terrain stability mapping has been completed for the majority of the forest district and replaces the use of ESA soils designations for the identification of terrain stability problems. However, only about two-thirds of this mapping was available in digital form for inclusion in the analysis database. Ministry of Forests soil specialists evaluated all landscape units in the Kootenay Lake Forest District and recommended that unmapped portions of the timber harvesting land base be treated as follows:

In all landscape units (LU) with adequate level D terrain stability mapping coverage, land base reductions for terrain instability were estimated using level D map labels (except K10 and K16 which used level B mapping). Land base reductions in unmapped areas were extrapolated from mapped areas. Terrain stability reductions for landscape units with inadequate level D mapping coverage were extrapolated from landscape units with similar geomorphology.

In the data package, the reduction percentage for Class IV and Class P was listed as 35%, and only for slopes greater than 60%. Upon review of the slope class data, however, it was decided that it would be more appropriate to apply a reduction percentage of 30% across all slope classes.

Table A-5a. Terrain stability classes and reduction factors

Category	Reduction per cent (%)
"U" (level D) and "V" (level B)	90
"P" (level D) and "IV" (level B)	30

Table A-5b. *Source information for landscape units with incomplete terrain mapping*

Landscape unit	Reference terrain data
K2	K3
K4	K1
K5	K3
K7	K9
K15	K16 (level B)
K17	K18
K21	K20
K22	K20
K23	K20
K24	K20

A.3.5 Areas considered inoperable

Forest cover mapping operability codes which describe the presence or absence of physical and/or economic limitations to harvesting, were used to identify land base suitable for inclusion within the timber harvesting land base. All areas labelled inoperable (operability code = I) without a logging history label were excluded from the timber harvesting land base.

Approximately 8% of the area harvested from 1993 to 1998 was labelled as inoperable. However, slope class data for harvested areas indicates that a disproportionate amount of the lower slope classes and higher site indices are being harvested (based on an internal review of 1993-1998 harvested areas and 1997-2001 Forest Development Plans (FDP)). Sensitivity analysis was used to examine the timber supply implications of uncertainty in the size of the land base.

A.3.6 Sites with low timber growing potential

Sites may have low productivity because of inherent site factors (e.g., nutrient availability, exposure, excessive moisture), or because they are not fully occupied by an ecologically adapted, commercial, tree species. All stands with forest cover inventory label site index estimates of less than eight metres at a breast height age of 50 years were excluded from the timber harvesting land base.

A.3.7 Problem forest types

Problem forest types are physically operable stands that exceed low site criteria but are not currently utilized or have marginal merchantability. These types are wholly or partially excluded from the timber harvesting land base.

Table A-6. Problem forest types criteria

	Characteristics	
Inventory type group	**Age class**	**Reduction per cent (%)**
Pw (27)	> 5 (> 80 years)	50
Cottonwood (35), AcDecid (36), DrDecid (38), Mb (39)	All	100
E(40), AtConif (41), AtDecid (42)	All	90

Data source and comments:

The data package proposed a 100% exclusion of white pine-leading stands greater than 80 years of age. This was revised to 50%, based on the expectation that some merchantable volume may come from secondary species in these stands.

After the data package was released, Cottonwood-leading stands were added to the list of inventory type groups completely excluded from the timber harvesting land base and the exclusion rate for Aspen-leading stands was increased from 50% to 90%.

A.3.8 Existing and future unclassified roads, trails and landings

Separate estimates were made to reflect the loss of productive forest to existing roads, trails and landings (RTL) and future RTL. Existing RTL estimates were applied as reductions to the current productive forest considered available for harvesting. Future RTL estimates were applied after stands are harvested for the first time in the simulation model.

All highways and some larger municipal roads are of a sufficient size to be mapped as polygons and classified and excluded as non-forest areas. The area occupied by various right-of-ways (e.g., existing roads) too small to be mapped as separate polygons were determined by overlaying right-of-way mapping with forest cover polygons. For each forest cover polygon, the area of right-of-way to be deducted from the polygon area was determined by the length of right-of-way intersected and an associated right-of-way width.

Existing roads and trails

The following corridor reductions were applied to the right-of-way lengths provided by the road overlay.

Corridor	Variable name	Width applied (metres)
Highways	Rd_hwy	30
Pipelines	Rd_pipe	30
Powerlines	Rd_pwrli	30
Railways	Rd_rail	21
Secondary roads	Rd_secd	20
Logging roads	Rd_log	10.1
Single line logging roads	Rd_trail	4

To account for some of the overlap between roads and riparian management areas, the roadway exclusion was reduced by 25% if a polygon also had a riparian reduction.

An average width was calculated for existing logging roads, based on estimated widths of permanently deforested right-of-way for permanent and temporary roads (16 metres and 7 metres, respectively), and an estimate of the relative amounts of permanent and temporary roads.

The area of all polygons with a logging history label was further reduced to account for trails and landings. The estimate originally provided by the district staff was 6.5%, but 7.5% was applied in data preparation. This may, therefore, slightly overestimate the area of existing trails and landings.

Future roads and trails

The majority (80%) of the area reductions for existing road corridors occur in stands which are less than 70 years of age. This age was selected as the division between stands with existing roads and trails (< = 70 years) and stands with future roads and trails (> 70 years). Within stands 70 years of age and less, the area in existing road reductions relative to the timber harvesting land base is 6.4%.

It was assumed that combined future road and trail reduction rates within stands greater than 70 years of age would be equivalent to existing road and trail reductions in stands 70 years of age and less. Mapped right-of-ways in stands greater than 70 years of age cover an area equivalent to 1.5% of the timber harvesting land base greater than 70 years of age. To ensure that the final reduction for future roads and trails equaled 6.4% of the land base in that age group an additional 4.56% of the remaining area of these stands was transferred to roads in the simulation upon harvest.

A3.9 Wildlife habitat reductions

In addition to wildlife habitat management provided by forest cover retention limits and wildlife trees and wildlife tree patches, it is anticipated productive forest land will be excluded from the timber harvesting land base to provide habitat for identified wildlife. In the Kootenay Lake TSA the following identified wildlife species have been recognized under the *Forest Practices Code* (FPC) *Identified Wildlife Management Strategy*.

Identified wildlife

Birds	Mammals	Fish
Western grebe	Fisher	Bull trout
American bittern	Grizzly bear	Reptiles
Prairie falcon	Mountain goat	Rubber boa
Lewis' woodpecker		
Bobolink		
Northern goshawk spp. Atricapillus		

Current management of identified wildlife has been limited to the delineation and protection of security and foraging cover for grizzly bears (as recommended in the *Kootenay-Boundary Land Use Plan*). Extrapolating current practices to all priority 1 and 2 grizzly areas (as described in *Kootenay-Boundary Land Use Plan* (KBLUP))within the Kootenay Lake TSA is expected to result in a land base reduction of approximately 1.0%. The data package indicated that this integrated wildlife management strategy (IWMS) for grizzly bear would be modelled by a 1.0% land base reduction in the analysis — because this is not current practice this was not incorporated in the analysis.

The Midge Creek Wildlife Management Area was not factored into the analysis because management guidelines have not yet been developed.

A.3.10 Cultural heritage resource reductions

An archaeological overview assessment has been completed for the Kootenay Lake TSA. No significant timber availability impacts have been noted with regard to archaeological sites and assessments.

Forest district staff do not anticipate significant additional cultural heritage area exclusions, with the exception of the Dewdney Trail. At this time the Dewdney Trail is the only heritage site that has been designated under the *Heritage Conservation Act*. According to management guidelines this area will be excluded from timber harvesting. The data package indicated that a planning cell code on the inventory file would be used to identify and exclude the trail from the timber harvesting land base, because this code was not available an alternative special area mapping code was used to identify and exclude the trail from the timber harvesting land base.

A.3.11 Riparian reserve zone reductions and wildlife tree patches

Management in riparian areas will be accounted for through an area deduction. Table A-7. indicates the widths of riparian buffers used to exclude area from the timber harvesting land base to account for special management in riparian areas. While some harvesting may occur in riparian management zones, an effective reserve can be calculated by multiplying the management zone area by the retention percentage. The total riparian area reserve consists of the reserve zone plus the effective reserve constituted by the management zone

Table A-7. Riparian reserve zones

Riparian feature class	Feature length (metres in timber harvesting land base)	Reserve width (metres)	Management zone width (metres)	Basal area retention in management zone (%)	Total riparian area reserve (metres)
S1	66 753	50	20	50	60
S2	644 551	30	20	25	35
S3	592 939	20	20	20	24
S4	19 778	0	30	15	5
S5	896 493	0	30	5	1.5
S6	49 445	0	20	5	1
W1	13 175	10	40	25	20 (18.75)[a]
W3	1 464	0	30	25	7.5(18.75)[a]
L1	38 814	10	200	25	60 (54.75)[a]
L3	4 313	0	30	25	7.5 (54.75)[a]

(a) Figures in brackets are weighted averages which were used for the wetland and lake riparian feature classes.

Data source and comments;

These figures reflect current management in the Kootenay Lake TSA.

A district wide riparian management area (RMA) classification for streams, lakes, and wetlands was developed for TSR 2 analysis purposes based upon the 1:50,000 scale *British Columbia Watershed Atlas*. This project yielded digital files with RMA classifications. These RMA classifications were assigned using a model derived to predict stream width using the stream order and stream magnitude of the *British Columbia Watershed Atlas*. However, on streams where fish inventory data exists within the *Watershed Atlas*, the classification is based upon field observed channel widths. A detailed explanation of the applied methodology is contained within the report *Riparian Management Area Classification for Kootenay Lake Forest District*, Geosense Consulting Ltd., March 1998.

A.3.12 Exclusion of specific, geographically defined areas

The following areas are not considered economic to develop and are therefore excluded from the timber harvesting land base used in the timber supply analysis.

Table A-8. Exclusion of specific, geographically defined areas

Planning cells	Location descriptors	Reason for exclusion
PC 0184	Hall Creek	Uneconomic to develop
PCs 0144, 0148, 0204-0216	East Creek Giegrich Creek	Uneconomic to develop
PCs 0086, 0095	Houston Creek	Uneconomic to develop
PCs 0070, 0073	Laidlaw Creek	Uneconomic to develop

Data source and comments:

While development proposals have been received for East Creek, more detailed planning will be required to determine the economic feasibility of the proposal. To date, the costs of roading and developing East Creek have prevented companies from proposing development there. Sensitivity analysis regarding uncertainty about the size of the timber harvesting land base will provide information about the potential timber supply effects of harvesting in East Creek.

A.3.13 Timber licence reversions

Timber licences and timber agreements are old tenure arrangements that give a licensee exclusive rights to harvest merchantable timber from an area that does not contribute to the TSA allowable annual cut. These areas revert to Forest Service jurisdiction after harvest and/or reforestation, according to provisions within the licence documents. Accordingly, these areas are usually included in the timber harvesting land base upon their reversion, and contribute to the medium- to long-term timber supply for the TSA. In addition, beginning at the time they are harvested, timber licence and timber agreement land areas are included in calculations regarding forest cover requirements.

Timber Agreement Land lot 896 and Timber Licence 504 are the only remaining tenures of their kind in the forest district. Lot 896 is expected to revert to the Crown in the year 2004. Timber Licence 504 is expected to expire in 2001, and assuming a 15-year period to achieve free-to-grow, will revert to the Crown ownership by 2014. These licences which together account for approximately 1200 hectares were included within the regular TSA timber harvesting land base. The inventory records approximately 325 hectares of mature timber on these licences, which was available for harvesting in the base case. Because volume from these areas does not contribute to the TSA AAC in the short term this represents a small (0.3%) overestimate of short-term mature timber supply.

A.4 Forest Management Assumptions

A.4.1 Utilization levels

The utilization levels define the maximum stump height, minimum top diameter (inside bark) and minimum diameter at breast height (dbh) by species, and are used in the analysis to calculate merchantable volume.

Table A-9. Utilization levels

	Utilization		
Analysis unit	**Minimum dbh (cm)**	**Maximum stump height (cm)**	**Minimum top dib (cm)**
All pine leading	12.5	30	10
Western redcedar > 140 years (in analysis units 4 and 5)	17.5	30	15
All others	17.5	30	10

Data source and comments:

These levels reflect current utilization standards, licence requirements, and current performance.

A.4.2 Volume exclusions for mixed species stands

One or more species in mixed species stands may be unmerchantable. For example, the deciduous species in a predominantly coniferous stand may not be harvested, or may only be partially harvested. The unharvested portion should not contribute to the estimated stand volume. Most deciduous-leading stands are excluded from the timber harvesting land base. For stands within the harvesting land base, Table A-10. indicates which portions which did not contribute to harvest volume forecasts.

Table A-10. Volume exclusions for mixed species types

Inventory type group	Species	Volume exclusion (%)
All coniferous leading	Deciduous (broadleaf)	100

A.4.3 Minimum harvestable ages

The minimum harvestable age is the time required for stands to grow to harvestable size, it defines the lower limit for harvesting. Harvesting may occur in stands at the minimum age to meet a harvest target for a short period of time or to avoid large and abrupt changes in harvest levels. However, at present, most stands are not harvested until well past the minimum timber production ages because of management objectives for other resource values (e.g., requirements for the retention of older forest).

A.4 Forest Management Assumptions

Minimum harvestable ages were specified as the age that achieves 95% of the culmination mean annual increment (CMAI). This criteria was obtained from major licensee forest development plans and silviculture prescriptions, and defines a balance between economic and volume-growth criteria. Table A-11. presents the minimum harvestable ages by analysis unit. The 95% CMAI criteria means that all stands will achieve a minimum of volume of 124 cubic metres per hectare by minimum harvestable age.

The strategy for defining minimum harvestable ages provided in the data package used a combination of biological productivity and standing volume as criteria depending on slope class. Upon reviewing harvest ages generated by this strategy it was apparent that harvest ages for only 2.6% of the land base were affected by the slope criteria. This was due to the overriding influence of the productivity criteria (95% of culmination mean annual increment) on most of the land base. Because the area affected was so small, the average differential specified by the slope criteria was not large, and the criteria would have been temporary since it only affected existing stands, it was decided that the added complexity associated with modelling the differential was not warranted.

A.4 Forest Management Assumptions

Table A-11. Minimum harvestable ages criteria

						Years to achieve			
Existing/ managed	**Leading species**	**Age group**	**Site index group**	**Analysis unit number**	**Initial timber harvesting land base (hectares)**	**CMAI**	**95% of CMAI**	**> 100 m^3/hectare**	**Minimum harvestable age (MHA)**
Existing	FD	> 140	> 20	1111	348	110	90	60	90
		1–140	> 20	1112	37 643	110	90	50	90
		> 140	14–20	1121	3 655	130	100	70	100
		1–140	14–20	1122	39 064	130	110	70	110
		> 140	< 14	1131	1 134	140	130	120	130
		1–140	< 14	1132	4 658	150	130	110	130
	CH	> 140	> 20	1211	386	90	70	50	70
		1–140	> 20	1212	2 241	80	70	50	70
		> 140	14–20	1221	7 126	100	90	60	90
		1–140	14–20	1222	5 781	90	80	50	80
		> 140	< 14	1231	11 228	140	110	80	110
		1–140	< 14	1232	3 983	140	110	80	110
	BS	> 140	> 20	1311	548	90	70	50	70
		1–140	> 20	1312	3 258	90	70	50	70
		> 140	14–20	1321	5 055	110	90	70	90
		1–140	14–20	1322	15 033	110	90	70	90
		> 140	< 14	1331	17 900	170	130	100	130
		1–140	< 14	1332	8 496	160	120	90	120
	Pl	> 140	> 20	1411	59	70	50	40	50
		1–140	> 20	1412	11 675	70	60	40	60
		> 140	14–20	1421	409	100	80	60	80
		1–140	14–20	1422	45 107	100	70	60	70
		> 140	< 14	1431	944	130	100	80	100
		1–140	< 14	1432	5 822	130	110	80	110
Managed	FD	N/A	> 20	2110	370	90	80	50	80
		N/A	14–20	2120	3 128	130	100	70	100
		N/A	< 14	2130	756	170	150	110	150
	CH	N/A	> 20	2210	242	80	70	50	70
		N/A	14–20	2220	1 499	110	100	70	100
		N/A	< 14	2230	469	150	130	90	130
	BS	N/A	> 20	2310	116	70	60	40	60
		N/A	14–20	2320	12 265	100	90	60	90
		N/A	< 14	2330	3 092	150	130	90	130
	Pl	N/A	> 20	2410	399	70	60	40	60
		N/A	14–20	2420	3 471	90	70	50	70
		N/A	< 14	2430	490	130	110	80	110

Data source and comments:

Ages calculated using criteria and yield tables.
CMAI = culmination mean annual increment;
MHA = minimum harvestable age;
FD = Douglas-fir, CH = cedar / hemlock, BS = balsam / spruce, Pl = lodgepole pine;
N/A = criteria not applicable.

A.4.4 Harvest scheduling priority

The data package identified that harvesting preferences were for stands of lower slope class and higher productivity. Review of the TSR 2 inventory data confirmed a slight preference for lower slope class areas. While 74% of recently harvested (age < 5 years) polygons are situated on slopes of 40% or less, only 58% of the timber harvesting land base is situated on slopes of 40% or less. Any preference for stands of higher site index could not be confirmed with the inventory information. While management objectives include harvesting older stands before younger stands, review of Forest Development Plan harvesting history suggests harvesting is occurring over a wide range of ages. It is believed that the logistics associated with non-timber objectives, existing access and harvesting patterns, and a limited quantity of available growing stock reduce the latitude for focussing the harvest on older stands first. To more closely approximate the observed harvesting pattern which is subject to many logistical and technical considerations, a random harvest queuing rule was chosen for the base case. Sensitivity analysis was used to investigate the relationship between the harvest queuing strategy and available harvest forecasts.

A.4.5 Unsalvaged losses

Unsalvaged losses account for average annual unsalvaged volume lost to insect and disease epidemics, fires, wind or other damage agents on the timber harvesting land base. Unsalvaged losses reflect only those areas where the volume will not be recovered or salvaged.

Table A-12. Unsalvaged losses

Cause of loss	Annual unsalvaged loss (m^3/year)	Per cent (%)
Fire	25 272	81.6
Insects	3 185	10.3
Windthrow	2 508	8.1
Total	30 965	100.0

Data source and comments:

Fire losses are based on a 20-year average of fire history records. Windthrow and insect loss estimates were derived from annual overview flights, ground surveys, professional knowledge and judgment of Forest Service staff, and licensee FDP information. More than two-thirds of the unsalvaged insect losses are attributable to mountain pine beetle. Root rot and white pine blister rust account for the greatest annual losses to disease, however these losses are primarily endemic as opposed to epidemic. White pine blister rust is widespread throughout the forest district, and few white pine stems mature beyond age class 4 (80 years old). Half of the area of natural white pine older than age class 4 was excluded from the timber harvesting land base.

A.4.6 Managed stands and regeneration assumptions

The silviculture program modelled in the analysis reflects the mix of treatments expected to be carried out in the Kootenay Lake TSA. Table A-13. shows the proportion of each analysis unit to be treated under each silviculture regime and the expected regeneration delay.

Growth and yield of recent plantations and future stands was modelled using managed stand yield tables (MSYTs) produced using the Ministry of Forests' table interpolation program for stand yields (TIPSY) growth and yield model (Version 2.1 AlphaD). Yield tables for the genetic improvement sensitivity analysis were compiled with TIPSY Version 3.0 B.

The data package OAF 2 values were specified as 15% — which is three times greater than the provincial standard of 5%. After further consideration of the information available for predicting Armillaria impacts, a more conservative approach was taken and the OAF2 value increased to 7% from 5% to account for Armillaria across all species. Sensitivity analyses were also completed to assess a full range of impact from Armillaria.

A.4 Forest Management Assumptions

The data package stated pre-commercial thinning density objectives. Because only a small amount of thinning has actually occurred (approximately 100 hectares per year), and little thinning is expected to occur in the future, thinning was not factored in to the yield tables used in the analysis.

Over the past four years, the Kootenay Lake Forest District has implemented a program to use genetically improved seed wherever feasible. At present, approximately 50% of planted stock is genetically improved, however, the genetic worth of much of this stock is low so that the TSA wide growth and yield gains are small. A sensitivity analysis was prepared using expected (adjusted for stock utilization) genetic worth values for the year 2008 (Lw – 3.39%, Fdi – 8.64%, Pli – 4.01%, Sx – 8.79%).

The data package included a section describing immature plantation history. The purpose of this section was to assist with the identification of areas which would be best modelled with managed stand yield tables. After reviewing the forest inventory file it was determined that the treatment history information was adequate for the identification of managed stands.

Table A-13. Regeneration assumptions by analysis unit

Species groups	Regen method	%	Regen delay	OAFs		Regeneration species composition	Initial density	Analysis unit numbers
				1	2			
Fd	Planted	90	2	15	7	Lw55Fdi25Pl15Pw5	3492	2110, 2120, 2130
Fd	Natural	10	3	15	7	Lw30Fdi25Cw25Pl20	3341	2110, 2120, 2130
C/H	Planted	100	2	15	7	Se40Pl25Lw20Cw15	2643	2210, 2220, 2230
B/S	Planted	100	2	15	7	Se50Pl50	2106	2310, 2320, 2330
Pl	Planted	85	2	15	7	Pl40Lw40Se20	2843	2410, 2420, 2430
Pl	Natural	15	3	15	7	Pl85Lw15	4379	2410, 2420, 2430

Data source and comments:

- Major licensee silviculture information system (MLSIS) and integrated silviculture information system (ISIS) data for the preceding five years of activity. The data package misstated the natural pine regeneration delay as 5 years.
- Initial densities are summaries of ISIS and MLSIS densities (planted plus ingress). Regeneration delay figures are district specific numbers generated from *Technical Report MIT-004: Regeneration Delay Validation and Effect on Allowable Cut in the Nelson Region* (Reichenback, 1996).
- Managed stand yield table operational adjustment factors (OAFs) have been developed for Armillaria root disease by the Nelson Forest Region. OAF 2 incorporates this work. However, due to uncertainty about losses to root rot, sensitivity analysis was performed around this issue.

A.4.7 Not satisfactorily restocked (NSR) areas

Forest district silviculture data, ISIS and MLSIS were used to develop a profile of land classified as NSR in the FIP file. This profile was used to assign NSR area within the timber harvesting land base to analysis units, and to provide an estimated rate at which the NSR is restocked.

The forest inventory planning file (FIP) identifies 12 751 hectares of NSR within the timber harvesting land base, 9290 hectares of which are three years of age or less. Using ISIS as a guide, 4252 hectares of the NSR under 3 years of age on the FIP file were assigned to age classes –3, –2, and –1 (assumed current NSR). The remaining area less than 3 years of age (9290 – 4252 = 5038 hectares) is believed to be unsurveyed but sufficiently regenerated and were assigned an age of 5 years.

The area of backlog NSR is being reduced by site prep and planting, resurvey, reclassification of areas with previously unacceptable stocking (420–700 well-spaced stems per hectare), and natural regeneration. Considering this, 79% (2713 hectares) of the remaining older (> 3 years) NSR area (12 751 – 9290 = 3461 hectares) was scheduled for regeneration in 7 years (assigned –7 age) and 21% (748 hectares) was scheduled for regeneration in 20 years (assigned an age of – 20 years).

Table A-14a. Summary of NSR categories

Analysis unit	Total area (hectares)	Categories of NSR (hectares)				
		Operational	Backlog operable	Backlog inaccessible	Backlog inoperable (uneconomic)	Backlog deferred
F	1 363	599	248	134	331	51
C/H	3 183	773	782	422	1 046	160
Pl	1 669	1 259	133	72	178	27
B, S	3 653	1 621	659	356	882	135
Total	9 868	4 252	1 822	984	2 437	373

Data source and comments:

ISIS/MLSIS Summary.

Description of NSR categories.

Operational NSR — this is NSR generated from current harvesting (industry appraisal and Small Business Forest Enterprise Program (SBFEP) funding sources), and represents recently harvested openings which have not yet been regenerated.

Backlog categories — all of these categories represent disturbance from harvesting, fire and pests which occurred prior to 1987.

1. Backlog operable — openings in this category are within the timber harvesting land base.
2. Backlog inaccessible — these openings are within the timber harvesting land base, however access is not available. They are usually the result of wildfire.
3. Backlog uneconomic — these stands, located outside the timber harvesting land base, are generally of fire origin and in upper slope and ridge locations. There is no intention to plant these areas, therefore they are excluded from the timber harvesting land base.
4. Backlog deferred — within the timber harvesting forest but not treatable with present silviculture tools.

Table A-14b. Not satisfactorily restocked (NSR) areas

		Hectares of NSR (age range years from now)			
Analysis unit	**Total area (hectares)**	**1-3**	**4-10**	**11-20**	**> 20**
F/L	1 032	599	340	60	33
C/H	773	773	1 073	186	106
Pl	491	1 259	182	31	18
S/B	1 772	1 621	905	156	89
Total	7 431	4 252	2 500	433	246

Data source and comments:

MLSIS/ISIS summary.

A.4.8 Objectives that require forest cover requirements

Objectives for biodiversity, visual resources, wildlife habitat and water quality and other general non-timber values were accounted for by applying of forest cover objectives on various portions of the land base. The following table lists the various forest cover requirements by landscape unit (LU) and biogeoclimatic ecosystem classification (BEC) associated with *Forest Practices Code* (FPC) landscape-level biodiversity objectives. Alpine forests and non-productive forest are not included in landscape-level biodiversity calculations, consistent with current management direction in the Kootenay Lake Forest District.

A.4 Forest Management Assumptions

For the base case, it was assumed that the forest outside the timber harvesting land base will continue to age over time, and therefore provide a larger amount of old forest. Sensitivity analysis examined the effects on timber supply if the inoperable forest continues to provide the same amount of old forest as it currently does (i.e., in effect no aging). The implications of specifying early-seral requirements and old-seral percentage requirements for the operable land base were also assessed.

A.4 Forest Management Assumptions

Table A-15a. Cover requirements by landscape unit for mature and old-growth forest

Landscape units	BEO	BEC / NDT	Minimum area greater than or equal to seral age (%)	Mature and old seral ages (years)	Maximum area less than 40 years (%)
K17, K18	H	ESSFwc4 / 1	54 28	120 250	17
K17, K18, K23	H	ICHwk1 / 1	51 19	100 250	23
K17, K18	H	ICHmw2 / 2	46 13	100 250	27
K10, K12, K23, K24, K26	I	ESSFwc4 / 1	36 19	120 250	22
K20, K21, K24	I	ICHwk1 / 1	34 13	100 250	30
K5, K6, K7, K25	I	ESSFwm / 2	28 9	120 250	36
K5, K6, K7, K8, K10, K12, K21, K25, K26	I	ICHmw2 / 2	31 9	100 250	36
K5, K6	I	ESSFdk / 3	23 14	120 140	46
K5, K6, K7, K8, K10, K12, K25	I	ICHdw / 3	23 14	100 140	46
K5, K6, K25	I	ICHxw / 4	34 13	100 250	30
K14, K15, K16, K20, K21, K22	L	ESSFwm / 1	19 19	120 250	N/A
K2, K3, K8	L	ESSFwm / 2	14 9	120 250	N/A
K11	L	ESSFwc4 / 1	19 19	120 250	N/A
K1, K4, K9	L	ESSFwc4 / 2	14 9	120 250	N/A
K1, K2, K3, K4, K9, K11, K14, K16, K20, K22	L	ICHmw2 / 2	15 9	100 250	N/A
K1, K2, K3, K4, K9, K11, K14, K15, K16	L	ICHdw MSdk / 3	14 14	100 140	N/A
K1, K4	L	ICHxw / 4	17 13	100 250	N/A

A.4 Forest Management Assumptions

Data source and comments:

The above forest cover requirements are from the *Biodiversity Guidebook* and are designed to meet established biodiversity emphasis objectives (BEOs — H is high, I is intermediate, L is low) in different natural disturbance types (NDTs). The minimum area for old-seral forest in landscape units with low biodiversity emphasis objectives were phased in over three rotations (240 years) beginning at one-third of the indicated percentage.

The column "Maximum area less than 40 years" lists the landscape unit biodiversity early seral requirements for application in sensitivity analysis.

A.4 Forest Management Assumptions

Table A-15b. lists forest cover requirements for wildlife, visual quality, watershed and general integrated resource management (IRM) values.

Table A-15b. Forest cover requirements — non-landscape unit specific

Zone or group	Green-up height (metres)	Green-up maximum allowable disturbance %	Older age (years)	Minimum area of older age retained %	Land base constraints apply to
Caribou ESSF	2	25	141	30	Operable area below 80% slopes
Caribou ESSF	2	25	251	10	Operable area below 80% slopes
Caribou ICH	2	25	141	40	Operable area below 80% slopes
Caribou ICH	2	25	251	10	Operable area below 80% slopes
Visual quality (R VQC)	See Table A-15c.	5	N/A	N/A	Crown forested area
Visual quality (PR VQC)	See Table A-15c.	15	N/A	N/A	Crown forested area
Visual quality (M VQC)	See Table A-15c.	25	N/A	N/A	Crown forested area
Domestic watersheds class 1	6	15	N/A	N/A	Total Crown area
Domestic watershed class 2	6	20	N/A	N/A	Total Crown area
Domestic watershed class 3	6	25	N/A	N/A	Total Crown area
Community watershed	6	20	N/A	N/A	Total Crown area
Ungulate winter range	2	25	81	40	Crown forested area
Integrated resource management	2	33	N/A	N/A	Timber harvesting land base

Data source and comments:

To more accurately represent current management, the maximum allowable disturbance for IRM areas was changed from the 25% specified in the data package to 33%. The two metre height refers to average stand or silvicultural height — this was translated into a 2.5 metre height for the purpose of estimating green-up height with Site Tools.

A.4 Forest Management Assumptions

Caribou forest cover objectives, including application of the cover requirements to the forested area below operability lines, are consistent with the targets specified by the *Kootenay-Boundary Land Use Plan,* and used to assess the suitability of Forest Development Plans. Table A-15b. also reflects *Kootenay-Boundary Land Use Plan* objectives for ungulate winter range and integrated resource management zone forest cover.

In order to more accurately reflect current management practices, UWR guidelines were changed from age class 6 and 45% specified in the data package to age class 5 and 40%.

Green-up heights for all watershed zones were reduced from nine metres in the draft data package to six metres in the analysis to account for "progressive green-up." This more accurately reflects how hydrological recovery occurs on a progressive, cumulative basis over time. Recovery does not change from 0% to 90% recovery in the year that a stands reaches nine metres in height. The maximum non-greened-up percentages for the various classes of watersheds are forest district estimates of what will result from the application of hydrologic assessments and constraints.

The three visual quality classes (VQCs) modelled were retention (R), partial retention (PR), and modification (M). Visually effective green-up (VEG) requirements vary by slope class as per Table A-15c. For the purposes of the analysis an area weighted average VEG height was determined for each VQC of each landscape unit.

Table A-15c. Visual effective green-up (VEG) heights by slope class

Slope %	0-5	6-10	11-15	16-20	21-25	26-30	31-35	36-40	41-50	51-55	56-60	60+
Tree height (metres)	3	3.5	4	4.5	5	5.5	6	6.5	7	7.5	8	8.5

A.4.9 Wildlife trees (WT) and tree patches (WTP)

Wildlife tree patches (WTPs) are the primary method used by major licensees to maintain mature stand structural elements over time. Fewer than 10% of these areas are two hectares or greater in size (based on professional judgment of Kootenay Lake Forest District staff). Table A-16. identifies the target cutblock-level wildlife tree retention (WTR) percentage for each cutblock by landscape unit. Using this table and the timber harvesting land base within each landscape unit variant combination, a TSA area-weighted reduction of 4.4% was determined. Because it is believed that one-half of these requirements can be met by areas excluded from the timber harvesting land base, this reduction was adjusted to a 2.2% reduction and implemented as a yield reduction on all stands.

Table A-16. Wildlife tree patch requirements

Landscape unit	Biogeoclimatic unit	Wildlife tree retention required (% of cutblock area)
K1	ESSFwc-4	7
	ICH-mw-2	3
	ICH-dw--	1
	ICH-xw--	0
	AT----p-	0
K2	ESSFwm--	3
	ICH-mw-2	5
	ICH-dw--	5
	AT----p-	0
K3	ESSFwm--	7
	ICH-mw-2	5
	ICH-dw--	5
	MS--dk--	9
	AT----p-	0
K4	ESSFwc-4	9
	ICH-mw-2	5
	ICH-dw--	0
	ICH-xw--	0
	AT----p-	0
K5	ESSFwm--	3
	ICH-mw-2	5
	ESSFdk--	5
	ICH-dw--	5
	ICH-xw--	1
	AT----p-	0
K6	ESSFwm--	3
	ICH-mw-2	3
	ESSFdk--	0
	ICH-dw--	3
	ICH-xw--	3
	AT----p-	0
K7	ESSFwc-4	1
	ICH-mw-2	3
	ICH-dw--	3
	AT----p-	0
K8	ESSFwm--	5
	ICH-mw-2	7
	ICH-dw--	5
	ICH-xw--	0
	AT----p-	0

(continued)

Table A-16. Wildlife tree patch requirements (continued)

Landscape unit	Biogeoclimatic unit	Wildlife tree retention required (% of cutblock area)
K9	ESSFwc-4	1
	ICH-mw-2	3
	ICH-dw--	3
	AT----p-	0
K10	ESSFwc-4	1
	ICH-mw-2	5
	ICH-dw--	5
	AT----p-	0
K11	ESSFwc-4	5
	ICH-mw-2	7
	ICH-dw--	7
	AT----p-	0
K12	ESSFwc-4	1
	ICH-mw-2	5
	ICH-dw--	7
	AT----p-	0
K14	ESSFwm--	0
	ICH-mw-2	3
	ICH-dw--	5
	AT-----p-	0
K15	ESSFwm--	0
	ICH-mw-2	0
	ICH-dw--	0
	AT----p-	0
K16	ESSFwm--	0
	ICH-mw-2	1
	ICH-dw--	5
	AT----p-	0
K17	ESSFwc-4	1
	ICH-wk-1	1
	ICH-mw-2	5
	AT----p-	0
K18	ESSFwc-4	1
	ICH-wk-1	5
	ICH-mw-2	5
	AT----p-	0
K20	ESSFwm--	3
	ICH-wk-1	7
	ICH-mw-2	3
	AT----p-	0

(continued)

A.4 Forest Management Assumptions

Table A-16. Wildlife tree patch requirements (concluded)

Landscape unit	Biogeoclimatic unit	Wildlife tree retention required (% of cutblock area)
K21	ESSFwm--	1
	ICH-wk-1	7
	ICH-mw-2	1
	ESSFdk--	0
	AT----p-	0
K22	ESSFwc-4	0
	ESSFwm--	3
	ICH-wk-1	3
	ICH-mw-2	1
	AT----p-	0
K23	ESSFwc-4	0
	ICH-wk-1	3
	AT----p-	0
K24	ESSFwc-4	3
	ESSFwm--	0
	ICH-wk-1	1
	AT----p-	0
K25	ESSFwm--	3
	ICH-mw-2	3
	ICH-dw--	3
	ICH-xw--	1
	AT----p-	0
K26	ESSFwc-4	0
	ICH-mw-2	1
	ICH-dw--	0
	AT----p-	0

Data source and comments:

The percentages required for wildlife trees were derived based on forest cover inventory files and direction in Table 20a of the *Biodiversity Guidebook*.

A.5 Volume Estimates for Existing Natural Stands

For existing natural stands, where density management has not been practised, the variable density yield prediction (VDYP) model, version 6.4a, developed and supported by the B.C. Ministry of Forests, Resources Inventory Branch, was used to generate timber yield tables. Table A-17. provides the net merchantable volume estimate (cubic metres / hectare) for each analysis unit number over a 300 year age range.

Table A-17. Volume estimates for existing natural stands (cubic metres / hectare)

Age	1111	1112	1121	1122	1131	1132	1211	1212
10	0	0	0	0	0	0	0	0
20	0	0	0	0	0	0	0	0
30	13	17	1	1	0	0	9	14
40	54	58	16	19	0	0	77	85
50	100	103	46	49	4	3	144	153
60	145	148	79	80	17	14	203	212
70	189	191	111	112	33	30	256	263
80	230	233	141	143	49	49	303	307
90	269	272	171	173	65	69	341	343
100	305	308	199	202	81	87	374	374
110	336	340	225	229	96	106	403	401
120	363	369	248	254	111	123	427	423
130	389	396	270	277	124	139	455	447
140	413	419	290	297	136	154	480	469
150	433	437	306	311	146	165	503	487
160	449	451	319	322	154	173	522	503
170	464	462	330	330	159	179	540	518
180	476	471	339	336	165	184	557	531
190	488	479	349	342	169	188	573	543
200	500	487	358	347	174	193	588	555
210	510	495	366	353	178	197	603	566
220	521	502	374	358	183	201	619	578
230	530	509	382	363	187	205	634	589
240	540	516	389	367	191	209	648	599
250	548	522	396	371	194	213	662	609
260	549	522	397	372	195	213	664	611
270	550	523	398	373	195	214	666	614
280	550	523	398	373	195	214	668	616
290	551	523	399	373	196	214	670	617
300	551	523	400	374	196	214	672	619
310	552	524	401	374	196	215	673	621
320	552	524	401	374	196	215	675	622
330	553	524	402	374	197	215	676	624
340	553	524	402	375	197	215	677	625
350	553	524	403	375	197	215	678	626

(continued)

A.5 Volume Estimates for Existing Natural Stands

Table A-17. Volume estimates for existing natural stands (cubic metres / hectare) (continued)

Age	1221	1222	1231	1232	1311	1312	1321	1322
10	0	0	0	0	0	0	0	0
20	0	0	0	0	0	0	0	0
30	0	3	0	0	1	10	1	2
40	16	42	0	1	46	65	10	19
50	64	101	9	14	114	130	45	55
60	115	156	40	42	174	187	91	96
70	161	204	80	76	226	238	134	136
80	202	247	119	110	269	280	171	170
90	237	282	154	141	305	316	203	199
100	267	313	185	168	335	346	230	225
110	294	340	212	193	359	372	254	248
120	316	363	237	215	380	393	275	268
130	341	387	261	238	399	415	295	290
140	363	409	283	258	417	434	314	309
150	383	428	303	277	431	451	330	327
160	402	445	321	293	444	466	346	343
170	418	459	337	308	455	479	359	358
180	433	473	351	321	465	490	372	372
190	446	485	363	333	473	501	383	384
200	460	497	376	346	481	510	394	397
210	473	509	388	357	488	520	404	408
220	487	521	400	369	494	528	413	419
230	500	532	411	381	500	536	422	430
240	512	542	423	392	505	543	430	439
250	524	552	433	403	510	550	437	449
260	527	555	439	408	512	552	440	451
270	531	557	444	412	515	554	443	453
280	533	560	449	415	516	555	445	455
290	536	562	453	418	518	557	447	457
300	539	564	456	421	520	558	449	458
310	541	566	460	424	521	559	451	460
320	543	568	463	426	522	560	452	461
330	545	569	466	428	523	560	454	462
340	547	571	469	430	524	561	455	464
350	549	572	471	432	525	561	456	465

(continued)

A.5 Volume Estimates for Existing Natural Stands

Table A-17. Volume estimates for existing natural stands (cubic metres / hectare) (concluded)

Age	1331	1332	1411	1412	1421	1422	1431	1432
10	0	0	0	0	0	0	0	0
20	0	0	0	1	1	0	0	0
30	0	0	77	50	6	13	2	1
40	1	2	154	112	40	56	8	5
50	8	14	218	167	82	99	30	25
60	22	33	272	214	118	137	55	53
70	46	59	318	255	151	172	79	78
80	69	83	357	291	180	202	102	102
90	92	104	391	323	206	231	122	125
100	113	124	421	352	229	257	141	146
110	131	142	448	379	249	281	159	165
120	149	158	473	403	268	304	175	184
130	166	176	495	426	287	325	191	202
140	182	192	511	442	300	339	203	215
150	198	207	523	453	311	350	213	225
160	212	222	532	461	320	358	221	233
170	225	235	538	465	326	362	227	239
180	237	248	540	467	329	363	231	242
190	249	260	540	465	331	362	233	244
200	260	271	544	468	334	364	236	247
210	271	282	547	471	338	366	240	251
220	281	293	550	474	342	369	243	254
230	290	303	554	477	345	372	247	257
240	299	313	557	480	349	374	250	260
250	308	322	560	483	352	376	253	263
260	311	324	563	485	354	378	255	265
270	314	326	565	487	356	380	256	267
280	317	328	567	489	357	382	258	268
290	319	330	569	491	359	383	259	269
300	321	332	571	492	360	385	261	271
310	324	334	573	494	361	386	262	272
320	326	335	574	495	363	387	263	273
330	328	337	576	497	364	388	264	273
340	329	338	577	498	364	389	264	274
350	331	339	578	499	365	390	265	275

A.6 Volume Estimates for Regenerated Stands

The table interpolation program for stand yields (TIPSY version 3.0a), developed by the B.C. Forest Service, Research Branch was used to estimate yields for managed stands. All stands identified by the forest inventory with silviculture treatment history, and all stands harvested in the future, are assumed to grow according to managed stands yield estimates from TIPSY. All analysis unit tables prefixed with the letters 'OG' are those generated for the old growth site index (OGSI) sensitivity analysis.

Table A-18. Volume estimates for regenerated stands (cubic metres / hectare)

Age	2110	2120	2130	2210	2220	2230	2310	2320
10	0	0	0	0	0	0	0	0
20	0	0	0	0	0	0	3	0
30	4	0	0	16	0	0	54	1
40	41	2	0	75	9	0	147	20
50	129	21	0	172	37	3	249	61
60	210	70	1	258	90	13	340	119
70	288	133	6	336	152	39	406	180
80	356	185	22	394	208	74	445	228
90	417	235	49	440	255	114	471	273
100	459	278	81	473	296	151	471	311
110	495	317	112	504	329	183	471	340
120	526	350	140	504	355	211	471	361
130	547	380	165	504	378	240	471	376
140	564	404	187	504	396	264	471	388
150	580	425	208	504	412	283	471	400
160	591	441	225	504	424	296	471	407
170	601	453	240	504	435	310	471	415
180	610	466	252	504	442	319	471	419
190	616	477	262	504	448	323	471	420
200	622	480	271	504	449	332	471	421
210	626	487	277	504	452	338	471	424
220	632	492	285	504	456	342	471	421
230	634	496	289	504	460	347	471	423
240	636	500	295	504	463	351	471	420
250	639	505	301	504	463	353	471	415
260	640	507	304	504	463	356	471	413
270	640	508	309	504	465	358	471	409
280	643	510	312	504	466	360	471	405
290	643	513	312	504	465	361	471	400
300	643	513	312	504	465	361	471	400
310	643	513	312	504	465	361	471	400
320	643	513	312	504	465	361	471	400
330	643	513	312	504	465	361	471	400
340	643	513	312	504	465	361	471	400
350	643	513	312	504	465	361	471	400

(continued)

Table A-18. Volume estimates for regenerated stands (cubic metres / hectare) (continued)

Age	2330	2410	2420	2430	OG_2110	OG_2120	OG_2130	OG_2210
10	0	0	0	0	0	0	0	0
20	0	9	0	0	0	0	0	0
30	0	70	15	0	4	0	0	16
40	0	158	56	4	40	3	0	75
50	4	239	115	17	129	23	0	170
60	14	299	169	41	210	76	3	256
70	35	356	219	73	288	140	16	334
80	66	398	261	106	356	194	45	392
90	100	433	294	136	417	242	83	439
100	134	458	323	163	458	287	120	474
110	165	458	347	187	495	324	153	505
120	191	458	364	205	526	360	181	505
130	216	458	381	224	547	389	207	505
140	238	458	394	239	564	413	229	505
150	259	458	405	253	580	433	250	505
160	275	458	413	265	591	450	266	505
170	288	458	420	273	600	463	280	505
180	298	458	423	281	610	474	295	505
190	307	458	426	287	616	483	305	505
200	314	458	427	292	622	491	311	505
210	320	458	428	294	626	497	318	505
220	325	458	426	298	632	502	323	505
230	325	458	427	299	634	506	328	505
240	327	458	425	302	636	511	331	505
250	331	458	424	302	639	515	334	505
260	333	458	423	301	640	518	337	505
270	332	458	423	302	640	521	340	505
280	331	458	424	302	643	523	344	505
290	331	458	421	301	643	526	343	505
300	331	458	421	301	643	526	344	505
310	331	458	421	301	643	526	344	505
320	331	458	421	301	643	526	344	505
330	331	458	421	301	643	526	344	505
340	331	458	421	301	643	526	344	505
350	331	458	421	301	643	526	344	505

(continued)

A.6 Volume Estimates for Regenerated Stands

Table A-18. Volume estimates for regenerated stands (cubic metres / hectare) (concluded)

Age	0G_2220	0G_2230	0G_2310	0G_2320	0G_2330	OG_2410	OG_2420	OG_2430
10	0	0	0	0	0	0	0	0
20	0	0	3	0	0	8	0	0
30	3	1	55	4	0	69	15	1
40	30	11	147	30	9	155	55	8
50	90	48	251	84	37	237	114	29
60	168	106	340	148	83	298	168	64
70	236	170	407	210	134	355	219	103
80	295	226	445	263	185	397	261	138
90	345	274	471	310	225	431	295	170
100	383	314	471	344	265	458	325	198
110	416	348	471	369	299	458	347	221
120	441	373	471	388	324	458	368	241
130	462	394	471	402	341	458	383	261
140	477	415	471	414	355	458	397	278
150	490	431	471	424	366	458	407	292
160	500	441	471	430	376	458	415	302
170	509	449	471	435	382	458	420	310
180	514	458	471	439	390	458	425	316
190	519	462	471	438	395	458	429	318
200	519	466	471	435	398	458	429	321
210	519	470	471	434	402	458	432	324
220	519	475	471	432	402	458	429	326
230	519	476	471	431	399	458	429	326
240	519	478	471	430	398	458	427	328
250	519	480	471	427	395	458	428	329
260	519	479	471	424	393	458	427	330
270	519	478	471	424	392	458	426	330
280	519	480	471	421	390	458	424	324
290	519	483	471	420	387	458	425	321
300	519	483	471	420	387	458	424	321
310	519	483	471	420	387	458	424	321
320	519	483	471	420	387	458	424	321
330	519	483	471	420	387	458	424	321
340	519	483	471	420	387	458	424	321
350	519	483	471	420	387	458	424	321

Appendix B

Socio-Economic Analysis Background Information

B.1 Limitations of Economic Analysis

The socio-economic analysis portion of this report identifies employment and income impacts, changes in government revenues, and community impacts as a result of changes in the TSA's harvest levels over time. Some of the assumptions used in this report are as follows:

- **Employment multiplier** — employment multipliers are used to estimate indirect and induced employment impacts of a change in direct industry activity. The calculation of employment multipliers is based on analytical assumptions and data collected at a specific time period. The multipliers reflect industry and employment conditions at that time and may not accurately reflect industry and employment conditions in the future.
- **Employment coefficient** — employment coefficients are ratios of person-years of employment per 1000 cubic metres of timber harvested. These ratios are used to estimate employment levels associated with alternative harvest rates. This method of analysis assumes that the industry structure will be the same in the future as it is today. While reasonably accurate in the short term, employment coefficients may change in the future due to changes in market conditions, product mix or production technologies.
- **Timing of impacts** — employment impacts are shown to occur simultaneously with a change in the harvest level. While this assumption is reasonably accurate for the harvesting sub-sector, employment estimates for the silviculture and timber processing sub-sectors may not be as coincidental. As well, indirect and induced impacts tend to occur over a longer period, as levels of business and consumer spending adjust to changes in harvest levels.
- **Operating thresholds of mills** — it is unlikely that impacts on timber processing employment due to changes in harvest levels will be in direct proportion to the harvest changes (i.e., a 10% change in harvest may not lead to a 10% change in timber processing employment). Impacts on timber processing employment are more likely to occur step-wise related to operating thresholds of mills. For example, if a mill's timber supply is reduced, its operating threshold is reached when the decrease in timber supply causes it to lay off a shift of workers or to close the mill, either temporarily or permanently. Conversely, if the timber supply to the mill is increased, a processing threshold is reached when the mill has to decide whether to add another shift of workers or new capacity to process the increase in timber supply. In both cases, the per cent change in employment in the mill would probably differ from the per cent change in the timber processed. Because mills have many different operating configurations, accurately predicting an individual mill's operating threshold is impossible. As a result, impact figures pertaining to employment in timber processing are best interpreted as size of change rather than as precise changes in employment levels.
- **Government expenditures** — provincial government expenditures are more related to government policy and population levels than to industry activity. As such, expenditures on education, health care and other government services are assumed to remain unchanged despite changes to the harvest level and subsequent changes in government revenues from the forestry sector. However, provincial government expenditures would likely change if a community's population significantly changes. This would amplify the community impacts of losses or gains in forestry sector jobs.
- **Proportional harvest reductions** — harvest reductions are assumed to be proportionately distributed among all licensees and all forms of tenure within the TSA.

B.2 Economic Impact Analysis Methodology

Data sources

Data for the socio-economic analysis were obtained from several sources. Harvest volume and stumpage data are from the Ministry of Forests. Timber flow and employment data are from responses to questionnaires that were sent to licensees, operators and processing facilities in the TSA. Other general economic data are from BC STATS, the Ministry of Finance and Corporate Relations, Statistics Canada and local communities. Estimates of taxes paid by the forest industry are from PriceWaterhouseCoopers.

Person-year of employment

The unit of measurement for employment is a person-year. A person-year of employment is defined as a full-time job, which lasts at least 180 days per year. Part-time jobs were converted to equivalent full-time person-years of employment.

To estimate employment and income impacts associated with changes in TSA timber harvest levels, the forestry sector was divided into three sub-sectors:

1) harvesting;
2) silviculture; and
3) timber processing.

Employment and income impacts were estimated in several steps. The first step was to assess current activity in each of the three sub-sectors. Then, indirect and induced employment and employment income impacts were estimated, using data from Ministry of Finance and Corporate Relations (1996) and Statistics Canada. Next, employment coefficients were calculated and then applied to the base case harvest forecast. Other indicators of the forestry sector's contribution to the provincial economy, such as government revenues and industry taxes were also calculated, using Ministry of Forests stumpage estimates and other data sources.

Employment — harvesting

Direct employment in harvesting consists of all woodlands-related jobs including harvesting, log salvage, planning and administration functions and log transportation. The employment multipliers used in this analysis define activities such as road building or maintenance work as indirect employment rather than direct employment because the forestry sector and other basic sectors purchase these services.

Data on employment, place of residence and timber flows were obtained from responses to questionnaires that were sent to licensees and operators in the TSA. The information was then used to estimate employment averages associated with harvest changes and the proportion of residents *versus* non-residents who work in the TSA.

Two estimates of direct employment in harvesting were calculated:

1) TSA direct employment in harvesting consists of employees who are engaged in harvesting and related activities within the TSA and who reside in communities within the TSA; and
2) Provincial direct employment in harvesting consists of employees who are engaged in harvesting, as above, plus those workers who reside outside the TSA, but who come to the TSA to work in harvesting and harvesting-related activities.

The estimates of TSA and provincial direct employment in harvesting were used to calculate employment coefficients per 1000 cubic metres. These employment coefficients were then used to estimate harvesting employment associated with the different harvest levels in the base case forecast.

Employment — silviculture

Silviculture employment consists of all basic and intensive reforestation activities, including surveys, site preparation, planting, fertilization, pruning and spacing. Silviculture employment data were collected from the Ministry of Forests and licensees whose tenures require post-harvest silviculture work. Most silviculture work is seasonal and silviculture employees usually only work part-time during the year. Because of this, information on silviculture employment was converted into equivalent full-time person-years of employment. Respondents were also asked to estimate the percentage of their silviculture employees who resided within the TSA and outside the TSA.

As with the harvesting sub-sector, two estimates of direct employment in silviculture were calculated: one for the TSA and another for the province. These employment figures were used to calculate employment coefficients for silviculture employment in the same manner as the employment coefficients for harvest employment.

Employment — timber processing

Information about employment, production and sources of timber was gathered from mills. Information was also gathered as to whether timber harvested from the TSA was processed within the TSA or outside the TSA. This information indicates the degree of dependence the mills have on timber harvested within the TSA. To estimate the share of processing employment supported by TSA timber, mill employment was prorated by the relative contribution of timber from the TSA to a mill's total timber requirement. For example, if 80% of a plant's timber supply is from the harvest of the TSA, then 80% of the employment in the plant would be attributable to the TSA harvest. Employment figures were also adjusted to reflect the residences of workers (i.e., those who lived within the TSA and those who lived outside the TSA). Employment in timber processing that is supported by chip by-products from milling operations was also similarly estimated.

As with the harvesting sub-sector, two estimates of direct employment in timber processing were calculated: one for the TSA and another for the province. These employment figures were used to calculate employment coefficients for timber processing employment in the same manner as the employment coefficients for harvest employment.

Indirect and induced employment estimates

Indirect employment in the forestry sector refers to those who provide goods and services to firms directly engaged in the basic forestry sector (for example, those who build or maintain road for log transport). Induced employment refers to those who provide the goods and services purchased by employees who are directly and indirectly engaged in the industry (for example, those who work in retail outlets). Indirect and induced employment figures were calculated using TSA and provincial employment multipliers developed by the Ministry of Finance and Corporate Relations.

Two sets of employment multipliers were calculated for this report: a migration multiplier and a no-migration multiplier. The migration multipliers assume that displaced workers will leave the region, reducing total income in the region by their full wage. The no-migration multipliers assume that displaced workers remain in the area, at least in the short term, and unemployment and other social safety net payments temporarily offset some of the income loss. Using the no-migration multipliers diminishes the degree of induced impacts associated with a change in direct employment.

The TSA and provincial employment multipliers used in the Kootenay Lake TSA analysis are shown in Table B-1.

B.2 Economic Impact Analysis Methodology

Table B-1. Employment multipliers, Kootenay Lake TSA

Forestry sub-sector	Kootenay Lake TSA migration multiplier	Kootenay Lake TSA no-migration multiplier	Provincial (Interior) migration multiplier	Provincial (Interior) no-migration multiplier
Harvesting	1.52	1.34	2.14	1.80
Solid wood processing	1.55	1.35	2.29	1.93
Plywood	1.55	1.35	1.93	1.64
Pulp	2.09	1.77	3.02	2.48

Sources: Ministry of Finance and Corporate Relations. 1999. The 1996 forest district tables.

Ministry of Finance and Corporate Relations. 1996. A provincial impact estimation procedure for the British Columbia forestry sector.

Estimates of employment income

Employment income was calculated using average income estimates for workers in the forest industry. Based on Statistics Canada data, the weighted average annual pre-tax income (less benefits) for forestry sector workers in 1999 was:

$46,956 for those working in logging and forestry services;

$44,980 for those working in solid wood manufacturing; and

$58,136 for those working in pulp and paper mills.

Those in indirect and induced occupations earned approximately $30,732. Income taxes were calculated based on marginal tax rates of 23-28% with one-third of the total income tax paid accruing to the province.

Employment estimates of alternate timber supply levels

To estimate employment generated by alternative timber supplies, the forecast harvest level is multiplied by the calculated employment coefficients. Note that employment coefficients are based on current industry productivity, harvest practices and forest management assumptions and will not likely reflect industry operating conditions in future years. Therefore, the employment estimates should be viewed as indicators of size of change rather than as precise estimates of changes in employment levels.

Provincial government revenues

Except for stumpage, royalty and rents, which are specific to the TSA, provincial government revenue impacts were estimated by using industry averages. Revenues per 1000 cubic metres of harvest, expressed as dollars per 1000 cubic metres, were calculated and applied to the harvest levels in the base case forecast in a manner similar to how employment impacts were estimated (Table B-2).

B.2 Economic Impact Analysis Methodology

Table B-2. Estimates of provincial government revenues, Kootenay Lake TSA

	Average annual revenue 1997-1999 ($ millions)	Revenue ($ per '000s m^3)
Stumpage and related payments[a]	7.80	12,940
Forest industry taxes[b]	4.66	7,729
Employee income tax[c]	6.37	10,570
Total	18.83	31,239

(a) Source: Ministry of Forests, Revenue Branch.

(b) Based on estimates by PriceWaterhouseCoopers. Includes taxes for logging, corporate income, corporate capital, sales, property and electricity.

(c) Estimated from Revenue Canada income tax rates and includes only the provincial share of income taxes paid.